AMERICAN MACHINIST

JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 13, No. 29. WEEKLY. | NEW YORK, THURSDAY, JULY 17, 1890. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

COPYRIGHT 1890, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Universal Sawing Machine.

We present herewith engravings showing the construction of a saw table which possesses some unique features, the principal one being that it has three spindles so arranged that any one of them can be brought into position to be used much more quickly than saws can be changed on an ordinary machine, and when any spindle is not in use it is standing still, and in no way interferes with the use of another.

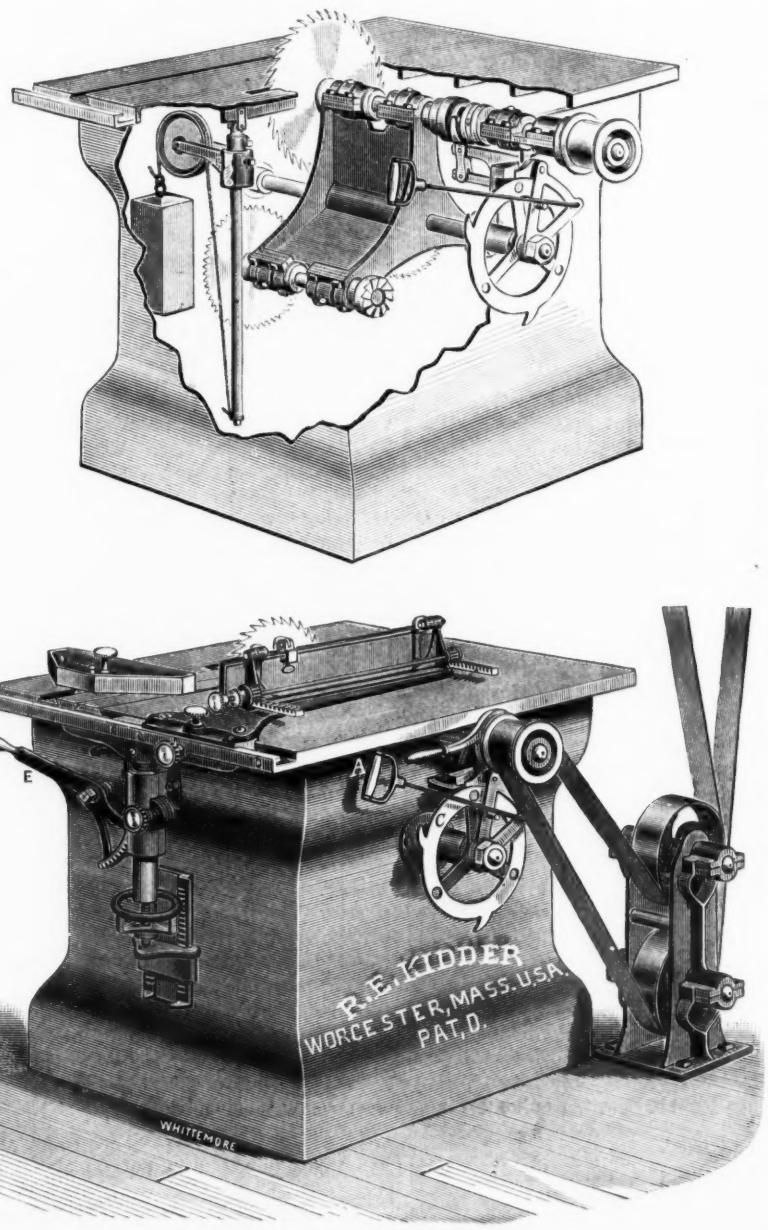
By reference to the cut showing part of the frame broken away, the construction of the machine will readily be understood. Vertically below the main driving shaft on which the pulley is fixed, is a heavy shaft passing through the machine from side to side, and on this is fixed a double spider of triangular shape as shown, at each of the three extremities being provided boxes for the saw arbors. These arbors are not driven by the belt direct, but by clutches which connect them with the main shaft already spoken of. This shaft carries the driving pulley at its outer end, has a substantial bearing each side of the frame, and at its inner end has a sliding clutch which can be made to engage with any of the similar clutches on the saw arbors as they are brought into line with it. At the outer end of the shaft which carries the spider is the wheel shown, which has three projections on its rim, with which the sector shown engages by means of a pawl. This sector is moved by the handle shown, and when this handle is pulled toward the operator the first effect is to draw out the stop pin from the hole in the rim of the wheel, and at the same time disengage the clutch.

The continued motion of the sector then turns the wheel by means of one of the projections mentioned, until the next hole in the rim of the wheel comes into line with the stop pin, when the pin enters by means of a spring, locking the arbor in position, and at the same time allowing the clutch to engage ready for driving. All this being done by one movement of the lever is, of course, done very quickly, and saws adapted for three different kinds of work can be kept mounted ready for use, and the trouble and loss of time involved in making changes avoided. The belt or driving power is in no way interfered with by this arrangement, but retains its efficiency unimpaired.

The table is hinged at the back, and is raised in front to gauge the depth of the cut, as in rabbeting, by two separate movements, one of which is a rack and pinion and the other a screw, either one being instantly available, the former for quick setting to height where great accuracy is not demanded, the latter where the depth of cut must be accurately gauged. The table is counterbalanced in the manner shown, so that it is very easy to raise to any desired height, and it can be clamped in any position. When the screw is to be used for adjusting the height of table it is done in the following manner: First raise by means of the lever to nearly the height required, and clamp; then bring up the bracket under the handwheel until it comes into contact with the pivot on the latter; the teeth on the side of the frame will hold it in position; then loosen the clamp and turn the wheel to complete the adjustment.

The entire machine is made of iron and steel, the table planed true and the frame so formed as to retain all sawdust, which is taken out by a door provided at the back.

An improved system of gauges is employed, the cutting off gauge being so made that either a square or miter is had without change; and it is also adjustable from 0 to 45°, and by turning one-quarter will give a double miter; that is, it will cut both ends of the work without turning it over or changing ends. The method of fastening the side gauge, or splitting fence, to the front of the table, which has been adopted, is thought to be a considerable improvement, as it does away with the cross-groove in the table. This gauge is also made to clamp at any angle from 0 to 45°, and can be very quickly and firmly clamped in place. It is provided with a rack and pinion for moving it to or from the saw. The arrangement for both gauges is such that all the nuts and binders for operating them are in front, and convenient to the operator. There is also an attachment to be clamped to the upper edge of the fence when cutting a number of pieces to a uniform length by means of the cut-off gauge, which obviates the inconvenience and danger usually attending the operation.



UNIVERSAL SAWING MACHINE.

The machine can be belted from above, below, or horizontally; the pulley stand, shown on floor, is to take the place of counter when driven from above. With this the floor space occupied is reduced to the minimum.

The machine here illustrated is of the following dimensions:

Table, 44x34 inches. Pulley on saw arbor, 3¾ inches diameter, 4-inch face. Hole in saw, 1⅛ inches. Will take three saws—one 15 inches, two 14 inches diameter. Speed of saw about 2,700. Tight and loose pulleys on countershaft, 8 inches diameter, 6-inch face; driving pulley, 24 inches diameter, 4-inch face; should make 450 revolutions. Weight, 1,050 pounds.

It is built by R. E. Kidder, Worcester, Mass.

Considerable rejoicing is being indulged in at the recent decision of the courts of New York State adverse to the sugar trust. We are inclined to think, however, that there is not so much in it that is favorable to the real interests of the people as there would seem to be at first sight. There are other States in which trusts can and do flourish, and so long as men desire to combine for such purposes, and are given the incentive for doing so, they will find ways of doing it, probably. That the men who make their money out of such operations are not very badly frightened at the decision, is shown by the fact that trust certificates rose in price at the exchanges immediately after the receipt of the news. But of course this is no argument against the continuance of efforts against them. We have faith to believe that a way will eventually be discovered for crushing them, and it seems likely that the laws relating to the formation of corporate bodies will be changed very much within the next few years. One of the difficulties to be encountered in doing it will be to so arrange matters that the formation and operations of stock companies for legitimate and proper purposes will not be unnecessarily or injuriously hampered.

Hints on Jig Making.

BY WENDELL WILLIS.

Jigs are usually designed to hold work in which it is necessary to drill one or more holes accurately, each piece like its fellow. The nicest judgment, mechanical ingenuity, fertility of invention and experience are necessary to design those which will be really satisfactory. To keep the cost as low as possible, to make it easily and quickly handled in changing from one piece to another, to make it conform in certain limits to certain machines, and above all to be practical, are points the designer must constantly have in mind. But not so much in the designing as in the construction we have to do. In these days, when accurate work is called for, the accuracy of distance of one hole from another hole or given spot depends upon the skill of the workman, and it is presumed he has availed himself of the tools necessary for his occupation.

Ten years ago height gauges and depth gauges, arranged to read to thousandths of an inch, were unknown; vernier calipers not in the hands of one in a thousand, and micrometers scarcely more common. Now there is no excuse for a workman's being unable to work to a thousandth or even greater refinement, except it be his incompetency.

To return to our jig, it being given us along with a thorough understanding of its requirements, and I hope a piece of the work to be done in it. We will first see that the planed surfaces are true, the sides and ends parallel and square (if so intended), and no visible defects are apparent.

Now we will proceed to roughly lay out our holes for the reception of bushings, studs, screws, etc. I say roughly, because it is not necessary at this stage to use any great refinement. Perhaps, if we have no given point to start from, we will find we can favor our jig to make it harmonize, especially if the body is a casting, by starting from the center of some boss, if we find some of the others a little out of the center, we can then favor them somewhat. The holes that demand accuracy we will drill and tap for a small screw—as few bushed holes will be less than ¼ inch—say about ⅛-inch screw, and this size will also be large enough for the largest holes. A bushing we understand to be a piece of steel, the proper length to steady our drill, bored, turned, hardened,

lapped to size of desired hole, and ground on the outside finally to fit tight in jig. We will take it for granted that one of these bushings is to be placed precisely in some predetermined spot. We have roughly determined its location, and now, by the use of a button, locate it exactly. Our button will be, in effect, a short bushing, a good general dimension being .5 inch long, .4 inch diameter, and if our screw is ¼ inch, say a ¼-inch hole. It is essential that the end used next work should be quite square with the body. We will want a washer to fit screw, and in diameter nearly the size of button. Now if our screw is ¾ inch long under head it will extend into work about 3-16 inch, which will be enough. Screw down sufficiently hard to keep button from slipping too easily and proceed to adjust button in its exact location, so its center will be the required center of hole. When we have this done, tighten up on screw and fasten work to face plate. Now with the point of our indicator resting on under surface of button, as near work as possible, and free to move up and down, but not sideways, true up to a nicety, remove screw with button and bore to required size.

Several of these buttons may be placed at one time on work, and it is often more desirable to do so, in order to facilitate getting the distance one from another.

If too near together, however, they may interfere with the use of the indicator, the end of which should be quite small, with the point slightly turned up.

This method will be found to give far better results than indicating from a center punch, for several reasons; real accuracy may be obtained in setting button, while our punch mark is usually placed by the eye, is liable to deceive us, may not be round, etc.

Another method in favor with many tool makers is to fasten work to platen of milling machine, and after starting from some hole, obtain distances to others by means of the graduated dials. One for the longitudinal screw is needed, and can be made by first preparing a circle of 25 holes, and using this to graduate a disk that can conveniently be placed where the gear usually is put on screw. The disk should have 250 graduations—obtained by 4 holes in our 25 circle—as the pitch of screw on Brown & Sharpe machine is 4, this will give us thousandths. The proper number for other machines may be readily reckoned. There are likely to be slight inaccuracies in the screws, which for close work should be allowed for by making trial cuts, and correcting as required. This is a far more expeditious way than by indicating, and on many jobs of a heavy character is to be preferred. However, a little variation *will* sometimes most unaccountably occur, despite the utmost care. The size of bushings for holes is seldom of much consequence within certain limits, so advantage of this may often be taken to correct them.

Where holes lie in a circle or part of a circle, the work can be attached to a face plate fitting spiral head in place of chuck to good advantage, the dividing of distance being accomplished very readily and accurately. The head, of course, facing spindle of machine, which for small holes should be fitted with quick speed attachment.

A good assortment of short stiff drills, mills, boring bits, test plugs, etc., are absolutely necessary where much of this class of work is to be done.

A test arbor should be kept for use in the milling machine to measure from, and a true center will be of utility in tapping, reaming, and the like.

A canal, which will afford a cheap and more direct means of communication between the west of France and the north, is that which was formally opened on Sunday week by M. Yves Guyot. It connects the Oise with the Aisne. Its length is 48 kiloms., and it saves a detour of 58 kiloms. Many serious difficulties have been encountered in carrying out the work, notably in the construction of the subterranean portion of the canal. This tunnel is 2,365 m. in length, and the cost of boring was about 10,000,000f. In this work both fire and water had to be contended with, and six years ago eighteen men were suffocated in the workings. The canal, which was made under the direction of M. Bœswilwald, has occupied ten years in construction.

Odontics, or the Theory and Practice of the Teeth of Gears.

BY GEO. B. GRANT.

NINTH PAPER.

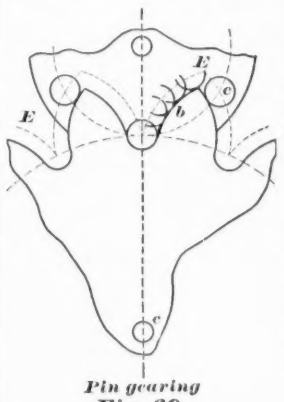
91.—THE PIN GEAR TOOTH.

The theory of the pin gear tooth is entirely beyond the reach of the "rolled curve" method of treatment, and, therefore, writers who have adopted that method have had to depend more on special methods adapted to it alone than on general principles. The result is that its properties are often given incorrectly, or with an obscurity and complication that is bewildering to the student. Although the tooth is one of the oldest in use, its theory is so difficult that its defect was not discovered until within a very few years, by MacCord, about 1880, and it was not until it was examined by means of its normals that a remedy for that defect was discovered.

By treating the curve on the general principles here adopted, as a special form of the segmental tooth, it can be studied with ease, and its peculiarities developed in a complete and satisfactory manner. The method, in general terms, is to find the conjugate tooth curve of the gear, for the given circular tooth curve of the pinion, and it presents no new features or difficulties.

92.—APPROXIMATE FORM OF PIN TOOTH CURVE.

Considered roughly, but accurately enough for teeth of small size, the form of the gear tooth *b*, Fig. 69, is a simple parallel to the epicycloid *E*, formed by the center *e* of the pin, and is to be drawn tangent to any convenient number of circles having centers on the epicycloid.

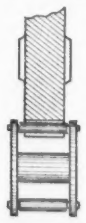


Pin gearing
Fig. 69.

The action is practically all on one side of the line of centers, the face of the gear tooth working with the part of the pin that is inside of its pitch line. It is, therefore, all approaching action when the pin drives and all receding action when the gear drives, and it is best to avoid the increased friction of the approaching action by always putting the pins on the follower.

93.—ROLLER TEETH.

The pin gear is particularly valuable when the pins can be made in the form of rollers, Fig. 70, for then the minimum of friction is reached. The roller runs freely on a fixed stud, or on bearings at each end, and can be easily lubricated.


Lantern wheel
Fig. 70.

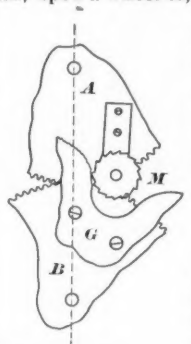
The friction between the tooth and pin, otherwise a sliding friction at a line bearing, is, with the roller pin, a slight rolling friction, and the sliding friction is confined to the surface between the roller and its bearings.

When the roller pin is used there can be no increased friction of approach, and the pin wheel can drive as well as follow.

For very light machinery, such as clock work, there is no form of tooth that is superior to the roller pin tooth, and, with the improvement to be explained, there is no better form for any purpose.

94.—CUTTING THE PIN TOOTH.

The pin gear tooth can be very easily and accurately shaped by mounting a revolving milling cutter *M*, Fig. 71, of the size of the pin, upon a wheel *A*, and causing it to roll with a wheel *B*, carrying the gear blank *G*. The mill will shape the teeth to the correct form.

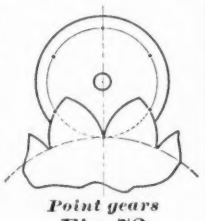


Pin gear cutter
Fig. 71.

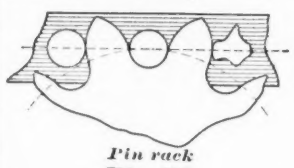
95.—PARTICULAR FORMS OF PIN GEARS.

When the pins are supported between two plates, as in Fig. 70, the wheel is called a "lantern" wheel, and is the most common form of clock pinion. The pins are sometimes called "staves," and are sometimes known as "leaves."

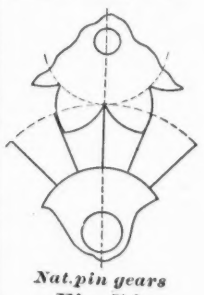
When the diameter of the pin is zero, Fig. 72, it being merely a point, the correct tooth curve will be a simple epicycloid.

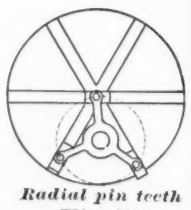

Point gears
Fig. 72.

When the pin gear is a rack, Fig. 73, the tooth bears on the pin only at a single point on the pitch line, and the action is therefore very defective unless the roller form of pin is used. This form is more properly a particular case of the involute tooth, for the shape of the pin is immaterial if it does not interfere with the gear tooth. The circle with center on a straight line is not an odontoid at all, for, although it coincides as a whole and for a single instant with a circular space in the gear, it has no proper and continuous tooth action.


Pin rack
Fig. 73.

The gears of Fig. 74, sometimes classed with pin gearing, are not pin gears at all. An epicycloidal face working with a radial flank is a very common combination.


Nat. pin gears
Fig. 74.

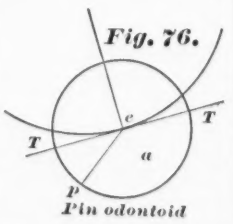

Radial pin teeth
Fig. 75.

When the diameter of the pin wheel is half that of the internal gear with which it works, we have the combination of Fig. 75. The pins may run in blocks fitted to the straight slots.

96.—CORRECT FORM AND EFFECT OF PIN TEETH.

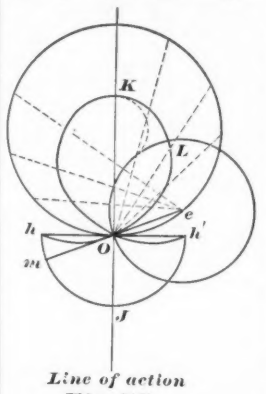
Although the pin tooth is apparently of a very simple form, a close examination will show that it is really quite complicated, and that its practical action is incomplete and defective. There is a cusp (16), and consequent failure in the action, that is of small importance when the teeth are small, but which is troublesome when they are large. This defect need not be considered when pinions for clock work are in view, but if pin wheels are to be used for large machinery and heavy power it is important.

If the pin *a*, Fig. 76, is examined as an odontoid, it will be seen that it is a true odontoid only within the line *TeT* that is tangent to the pitch line at the center of the pin, for all normals, as *pe*, from points outside of that line, intersect the pitch line at the center.



Pin odontoid
Fig. 76.

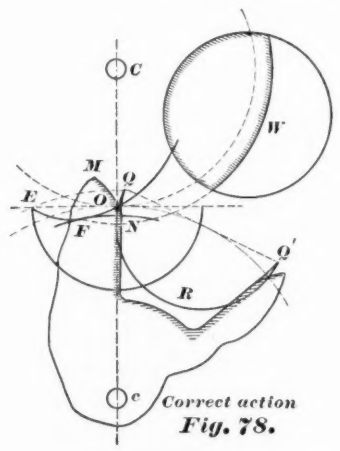
Drawing the normals, which are radii of the pin, we can easily construct the line of action and the conjugate tooth curve. The line of action, commencing at the pitch point *O*, Fig. 77, is there tangent to the line *eOm*, which passes through the center *e* of the pin, curves toward *Oh*, the tangent to the pitch line at the pitch point, and touches it at the point *h*, at the distance *Oh*, equal to the radius of the pin. From the point *h* it follows the circle *hJh'* to the point *h'*, thence returning to the pitch point and forming the loop *OKL*.



Line of action
Fig. 77.

From the center *c* of the gear, Fig. 78, we can always draw a tangent arc *FN* to the line of action at the point *F*, and therefore there will always be a cusp at *N* on the tooth curve. The tooth curve must end at the cusp, and, to avoid interference, the pin must be cut off at the arc *W*, drawn through the point *F*, from the center *C*.

The whole pin is generally used, and when it is a roller it must be whole, and



Correct action
Fig. 78.

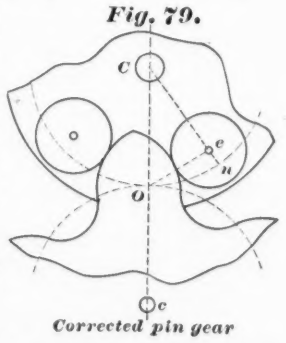
then interference can be avoided only by cutting away the tooth curve until it will allow it to pass.

The complete tooth curve has a first branch *NOM*, Fig. 78, which is the only part that can be used, an inoperative second branch from the first cusp *N* to the second cusp *Q* on the arc *EQ*, and thence an inoperative circle *ORQ'*.

97.—AN IMPROVED PIN TOOTH.

The cause of the broken action of the pin tooth is the cusp, which is always present when the center of the pin is on the pitch line, and it can be avoided by placing the center back, as in Fig. 79, to such a distance inside the pitch line that the cusp does not occur.

Fig. 79.



Corrected pin gear

When the center of the pin is inside the pitch line, the whole circle of the pin is a true odontoid, and the distance *en* of the center from the pitch line can be so chosen that the cusp is not formed.

This distance does not appear to be subject to any simply stated rule, but in the single case of the pin rack it is determined by the formula:

$$x = \frac{2}{27}\,\frac{d^2}{D},$$

in which x is the required distance *en*, D is the diameter of the gear, and d is the diameter of the pin. Applying this formula to the case of a gear of twelve teeth working with a pin rack, the diameter of the pin being half of the pitch arc, we find that $x = .01\ d$, or about one-hundredth of the diameter of the pin. A very small displacement will generally avoid the cusp.

The action will be improved by placing

the center of the pin considerably further back than is strictly required, since the wear is concentrated on a small part of the tooth curve, when the cusp is barely avoided. The distance *en* should be about one-tenth of the diameter of the pin to secure the best average result. If the angle *CeO*, Fig. 8, is not less than a right angle, there will be no cusp on the gear tooth if the diameter of the gear is greater than that of the pin.

Separators and Reheaters.

The accompanying illustrations represent a new design of separators employed for separating water from steam; and they also show a separator and reheater combined. These separators are very simple in construction, they are durable, require very little or no attention, and can be readily applied to almost any engine. The principle upon which these separators act is to impart to the steam a violent whirling motion, which causes the suspended water to be thrown against the walls of the outer casing or shell, from whence the force of gravity causes the water to collect in a receiving chamber, and from there it is returned to the boiler. In applying a separator, no change in the arrangement of the steam pipe needs to be made, as the separator forms part of the same. All that is necessary is to cut a portion of the steam pipe out, put two flanges on the ends, and bolt the separator between them.

Fig. 1 represents a horizontal separator; and Fig. 2 an end view of the same. It may be said that this separator is composed of two principal parts, namely, the outer shell or casing *A*, and the hollow core *B*, which is comparatively large in diameter near the center, and is gradually reduced to a point at the ends forming a conoidal surface. A number of wings *C C* are cast to the outer surface of this core, and extend spirally along the surface. This core is arranged concentric with the casing *A*, and is firmly held in position at one end by the wings *C C*, which for a short distance are in contact with the casing; the other end of the core is provided with three projecting arms *E*, which are in contact with the end of the nozzle A_3, the latter also clamps the core firmly in position when its flange *F* is bolted to the casing. The chamber *D* is cast to the casing and forms a reservoir for the water which has been separated from the steam. A number of cross-sections of the casing *A* and the core *B* are shown directly below Fig. 1; the dotted lines marked *y y*, in all these sections pass through the same two wings, and show the fractional part of the pitch of these wings between any two sections. It will be noticed that one face of each wing is tangential to the surface of the core, the other surface approaches a radial surface. The object of this construction is twofold; first, as the steam approaches the separator through the steam pipe A_2, the aim is to spread, or, so to speak, expand the solid body of steam gradually into an annular body, and this is perfectly accomplished by making it to flow over the conoidal suface of the core; the result of this is that the whirling motion acts on all the suspended particles of water. If, on the other hand, the solid body of steam had not been formed into an annular one, the whirling motion could not act on the particles of water in the center. Second, the object aimed at by placing the wings spirally along the surface of the core, and forming one of the sides of these wings tangential to the surface of the core, is to divide the steam into several streams, and give to each a compound whirling motion. The result of all this is that, as steam enters the separator at A_2, a violent compound whirling motion is imparted to all the particles of steam and water, all the heavier particles are thrown against the casing, and the water thus separated from the steam flows into the chamber *D;* from whence it is conducted back into the boiler, and leaving the dry steam to flow out of the nozzle A_3.

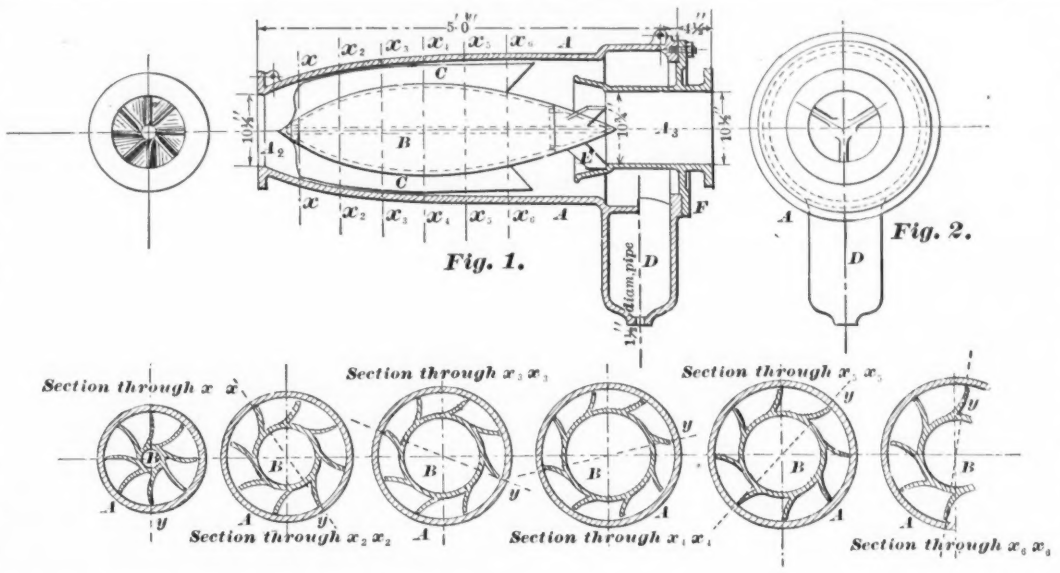
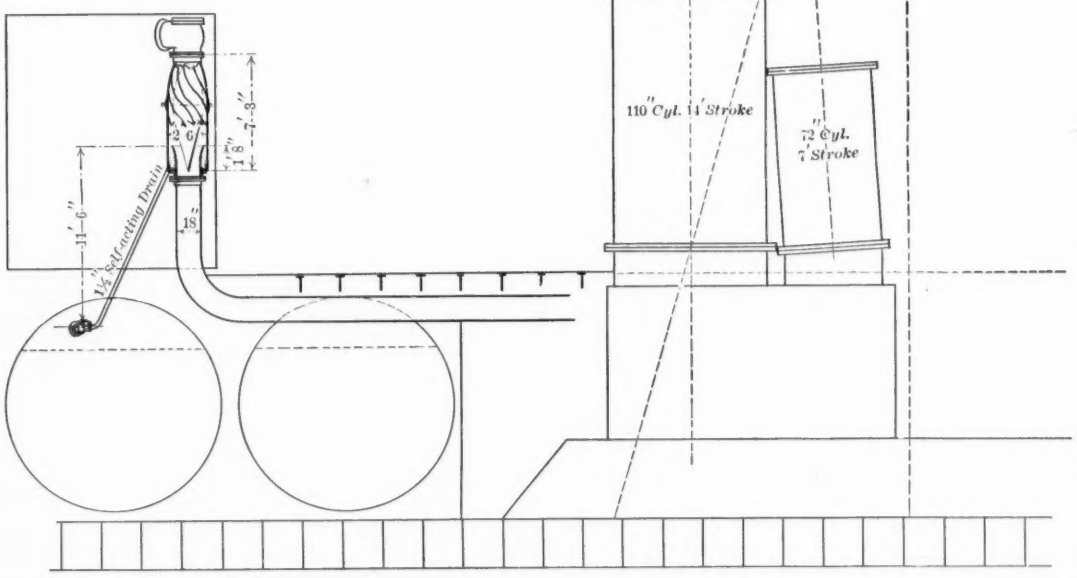

Section through x x
Section through x₃ x₃
Section through x₅ x₅
Section through x₂ x₂
Section through x₁ x₁
Section through x₆ x₆

Fig. 1.

Fig. 2.

Fig. 3 shows a separator applied to a steam pipe of a compound beam engine. In this case it is placed in a vertical position. The form of this separator is somewhat modified, but the principle of its action remains unchanged. Here the bottom of the outer casing forms the reservoir for the water, which is drained off by a pipe leading to the boiler; this pipe has a self-acting check, so that the separator needs no more attention than the main steam pipe.

Fig. 3.



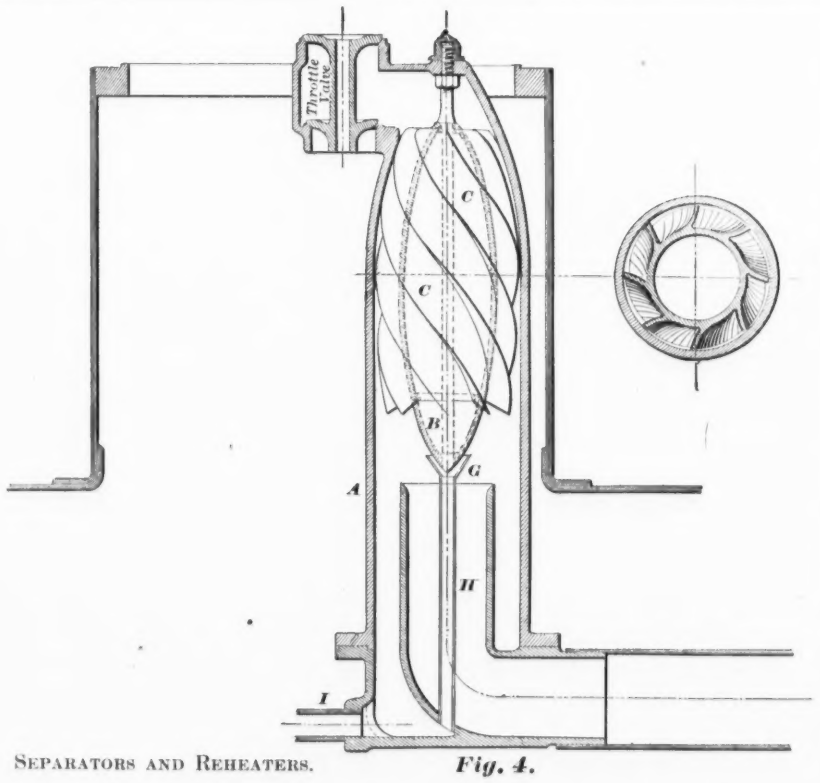


Fig. 4.

Fig. 4 represents the separator applied to a locomotive boiler; it is placed inside of the dome. The manner of holding the core *B* rigidly in the casing *A* is plainly shown. The pipe *H* with the bell-shaped receiver *G* is for the purpose of gathering any water which may be carried along the surface of the core *B*, and is conducted through the pipe *I*, which has a self-acting check, not shown here, back into the boiler. In applying this separator to a locomotive, nothing needs to be changed, excepting the throttle pipe. We are not aware that this separator has as yet been tried on a locomotive, but the inventor is of the opinion that it must act very effectively, and avoid the evils and damages caused by the water being carried from the boiler into the cylinder. There is nothing about the device to get out of order, and it requires no more care than the ordinary throttle pipe, which are very important features about mechanical devices which are placed out of sight and cannot be reached, like the throttle pipe of a locomotive. Figs. 5 and 6 represent a horizontal separator and reheater combined. In this case the water is not only separated from the steam, but the latter is also reheated, and some of the water re-evaporated. The principle of the action of separating the water from the steam is the same as in the other separators; but on account of the large steam pipe, 21 inches diameter, for which this separator is designed, and on account of the double duty which it has to perform, the construction of the casing *A* and the core *B* is somewhat modified. For instance, in this case it is deemed advisable to make the core in three pieces as shown, and bolted together. The casing *A* is made of two shells, leaving an annular space *O* between them. Live steam is admitted through the valve *K* into this space, and from there it is conducted through the pipe *M* into the core. The valve *L* is for the purpose of draining off the water which collects in the steam space *O*. The steam to the engine enters the separator at A_2, passes through the spiral channels as before, where the water is not only separated from the steam, but the latter is also reheated by the live steam in the casing and core. The water which is not re-evaporated collects in the reservoir *D*, from whence it is conducted into a drain tank, and the dry steam is discharged through A_2.

This device is well adapted for compound and triple expansion marine and pumping engines where high efficiency is sought. In compound engines the difference in the temperature of the steam in the high-pressure cylinder and that in the low-pressure cylinder is in round numbers 90 degrees; and the difference in the temperature of the steam in the high-pressure cylinder and that in the low-pressure cylinder of a triple expansion engine is from 120 to 140 degrees, hence a great advantage may be gained by placing the reheater between the two cylinders in a compound engine, and between the intermediate and low-pressure cylinder of a triple expansion engine, and reheating the steam before it enters the low-pressure cylinders, supplying the latter with dry steam of high temperature, and avoiding the danger of accumulation of water, and breaking out the cylinder heads.

A number of these separators have already been put in actual practice, and it is claimed that they work well and accomplish the object for which they have been designed in a very satisfactory manner. The separators have also been applied to an exhaust steam pipe, and employed for extracting the grease from the exhaust steam. These separators are patented by Jos. De Rycke, mechanical engineer and marine architect, 94 Liberty St., N. Y.

A Factory Cost System.

BY WILLIAM KENT, M. E.

(*Concluded.*)

If the cost ledger is strictly kept, and the general factory expense account completely distributed, so as to wipe it out at the end of the year, apportioning it among the accounts representing value of materials, tools, etc., on hand, the cost ledger should show neither profit nor loss, and in the general books of the concern the factory account, in which is lumped all the transactions between the general office and the factory, should also show neither profit nor loss, but in these books the profit and loss due to manufacturing should appear in merchandise account, that account being charged with merchandise at the factory valuation, plus cost of warehousing and shipping it, and credited with sales.

As an instance of this method of causing manufacturing accounts to show neither profit nor loss, I may mention the case of an iron works producing pig-iron only, with which works I was once connected. The bookkeeper's rule was, "Charge pig-iron account with the whole cost of making pig-iron each month, including every item of general expense. Credit pig-iron account and charge the company's general office with the pig-iron made at the same cost." In one particular month, on account of extraordinary repairs and small production, the cost of pig-iron thus charged was $139.42 per ton. It was all charged to the general office at that figure, so that pig-iron account showed neither profit nor loss, but in the company's general books the loss would appear due to its buying pig-iron from the blast furnace at $139.42 per ton and selling it at less than $30. This loss would be offset in succeeding months by buying the pig iron from the furnace at say $20 per ton, and selling it at $25 or more.

The following is an illustration of the entries in the cost ledger and in the shop order book for the manufacture of a portion of a weighing scale. The first is the cost ledger:

COST LEDGER.
Dr. SIDE.
BASES FOR COMMON SCALE.
P. 1.

Date.	Invoice or S. O.	No. Pieces.	Article or Operation.	Rate.	Amount.
Jan. 12...	B. M. I. Co.	260	Base Castings.....	16.4	$42 64
Feb. 1...	514	259	Bases Machined, 1 scrap.....	5.04	14 00
" 10...	J. H. B.	259	(Cost machined, 21.44c. ea.) Japanning.....	3.	7 77
			(Cost japanned, 24.44c.)		
Mar. 10...			Less Cr. Side.....		$64 24
April 1.....		159	Balance on hand.....		$40 06

Cr. SIDE.

Date.	Charge. P.	Charge. S. O.	No. Pieces.	Articles.	Rate.	Amount.
Mar. 10...	85	610	100	Bases.....	24.44	$24 44

The cost ledger thus shows the three principal items which go to make up the total cost of bases, 24.44 cents each, viz.: Castings, 16.4c.; machining, 5.04c., and japanning, 3c.; also the balance remaining on hand and their cost. If it is desired at any time to know the details of the cost of machining, the S. O. number 514 refers to the shop order book, where the several operations of gating, spotting, drilling, tapping and inspecting are found, together with the percentage added to cover general factory expense. The cost ledger being a very much condensed record, a few lines only being given to each piece, the book should last several years, giving thus great facility for comparing the cost of a piece or structure when made at different times and under different circumstances.

SHOP ORDER BOOK.

Card No. 514.....Operation, Mach'g Bases.
Issued Jan. 15.....for C. C. Scales.
Returned Feb. 1.....

ARTICLES.	CR. P.	PIECES OR LBS	RATE.	AMOUNT.	
Base castings	1	260	16.4	42	64

OPERATION.	WORKMAN.	HOURS OR PCS.	RATE.	AMOUNT.
Gating.....	21	7½	20	$1.50
Spotting.....	16	10	15	1.50
Drilling.....	15	15	12	1.80
Tapping.....	20	10	10	1.00
Inspecting...	7	5	25	1.25
				7 05
Add. Fact. Exp., 100%.....				7.05—14.10

Returns (1 spoiled), 259 made, cost $52 73=21 44c. each.

Charges.		Credits.	
P. 1	$14 09	Labor....	$7 05
P. 251. Scrap...	01	Fact. Exp.	7 05
	$14 10		$14 10

Entered in C. L.

The cost ledger and shop order system here illustrated will be found applicable also to jobbing work, the heading on the cost ledger pages either being the name of the party for whom the job is done, or the name of a branch of his work if it is desired to keep the cost of various details of it separate. The shop order book and the shop order card are kept exactly the same as they are for manufacturing for stock. In the Torsion Balance factory no difficulty was found in using the same books for regular work and for outside jobbing work. For the latter one page of the cost ledger would be headed, "John Jones & Co.'s machine," for instance, and on this page would be a record of the invoices of material purchased for the machine, followed by a line for each shop order number, thus:

Date.	S. O.	No. Pieces.	Article.	Rate.	Amt.
Apl. 10	610	500	Making Piece A.	11	$55.00

The system thus described forms a complete record, both condensed and in detail, of the cost of every structure, piece, operation and element of expense. It is not at all difficult to keep, if once properly understood; but it needs careful watching by the cost clerk to see that the entries are made to the proper accounts. The actual labor of making the entries is easily performed by a clerk of the ordinary grade of entry clerk or assistant bookkeeper.

In addition to the system of keeping the costs of each structure, piece and operation, an additional record should be kept giving a weekly or monthly distribution of the whole expenditure of the factory, including the amounts shown in the invoices and in the pay-rolls, into several general cost accounts, which are kept in the general factory ledger. These are: Manufacturing account, the Dr. side covering expenditures for labor and material on articles manufactured for sale; tools and equipment, including cost of tools, etc., purchased or made in the factory; models and experiments; patterns; repairs; factory supplies; and general factory expense. This distribution has nothing necessarily to do with the cost ledger nor with the cost of any particular piece; but it is of great value in preserving a record of the general conduct of the business and of the ratio which the non-productive factory expense account bears to the productive manufacturing account, or to those accounts which represent permanent investments, such as tools and equipment.

The weekly distribution of labor is made from the labor tickets at the same time that they are being posted into the shop order book upon a blank headed as below:

For the purpose of easily making this distribution of labor it is convenient to have all the "P numbers" on the time cards refer only to the cost ledger accounts which are grouped under the general ledger headings of "factory expense" and "repairs," assigning a certain group of pages in the cost ledger to these accounts, the numbers of which pages can easily be remembered, such as P. 1 to P. 40. The "tools and equipment," "models and experiments," and "patterns" account refer also to certain groups of pages in the shop order or auxiliary books, such as 40 to 60, 60 to 80 and 80 to 100. The numbers which refer to manufacturing account only, that is, to work done on pieces or structures manufactured for sale, may be higher numbers running from 200 upwards. Thus, as soon as a number is seen in either the "P." column or the "S. O." column in the time card it is at once known whether the work is for manufacturing account or for one of the other general accounts, and this will be found greatly to facilitate the distribution of labor into these general accounts. The distribution is also made easier by having some of the workmen regularly engaged in one class of work only; thus a model maker's whole time, 60 hours in a week, might be on one order under the general head of models and experiments; a tool maker would put 60 hours on one order under tools and equipment, etc.

From the distribution of labor blank an entry may be made, either weekly or monthly, into the general factory ledger, crediting labor account, and charging manufacturing, tools and equipment, and the other debtor accounts with their respective totals.

A similar distribution of invoices is made by using a blank, called an invoice register, with headings as shown below.

The bills, after being approved and checked, are put in a drawer till the end of the month, then sorted and arranged alphabetically and by dates, compared with statements received, and entered on the register. From the footings a debit entry may be made in the general ledger, charging the manufacturing and other debit accounts, and crediting the parties from whom the goods were purchased.

At the end of six months or a year the general factory expense account is charged with the general factory supplies used, and with depreciations, and then it is balanced by crediting it with the percentage, which is added to the labor cost of work done for manufacturing, tools and equipment, patterns and other accounts representing valuable articles, to cover their share of factory expense. Thus, suppose the charges to the several accounts during say six months were as follows:

	Labor.	Invoices.
Manufacturing account.	$11,500	$2,000
Tools and equipment....	1,500	5,000
Models and experiments.	1,000	200
Patterns.....	500	300
Factory supplies.....	——	1,000
General expenses.....	4,200	2,000
	$18,700	$11,500

The inventory shows that of the materials which were bought on invoices and charged

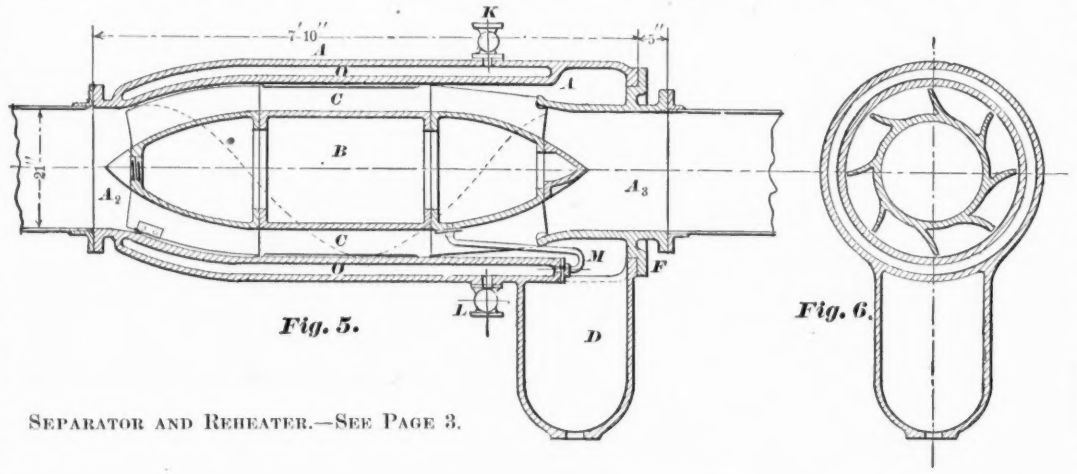


Fig. 5.

Fig. 6.

SEPARATOR AND REHEATER.—SEE PAGE 3.

DISTRIBUTION OF LABOR *for Week ending Friday*.....189

Workman's Number.	Workman's Name.	Mfg. Account. Hours.	Mfg. Account. Amount.	Factory Expense. Hours.	Factory Expense. Amount.	Tools and Equipments. Hours.	Tools and Equipments. Amount.	Models and Experiments. Hours.	Models and Experiments. Amount.	Patterns. Hours.	Patterns. Amount.	Repairs. Hours.	Repairs. Amount.	Hours.	Amount.	Rate.	Total Hours.	Total Amount.

INVOICE REGISTER. *Month of*.....189 *Page*.....

Date.	Name.	Kind of Goods.	Amount.	Mfg. Account.	Factory Supplies.	Factory Expense.	Tools and Equipment.	Patterns.	Repairs.	Models and Experi-ments.

to general expense account, such as fuel, water, gas, etc., besides other invoices, as taxes, insurance, etc., no value remains in sight; also that of the $1,000 of supplies charged, only $500 worth remain; that tools and equipment have depreciated in value by an amount estimated at $500; that models and experiment account have depreciated $1,000, and patterns $500. General expense account is then increased by the following entry:

General expense	2,500	
Dr. To tools and equipment		500
To models and experiments.....		1,000
To patterns.....		500
To factory supplies.....		500

The balance of general expense account is now 4,200 + 2,000 + 2,500 = 8,700, which is to be divided among the accounts representing value according to the labor spent upon them, thus:

Sundries to general expense:	
Manufacturing account, 60 % on 11,500.....	..6,900
Tool and equipment account, 60 % on 1,500.....	900
Models and experiments account, 60 % on 1,000..	600
Patterns account, 60 % on 500...	300
	8,700

If the percentage added in the shop order book to the labor cost of articles, tools, etc., made during the year, and carried thence to the cost ledger, was 60 per cent., then the inventory value of these accounts, as summed up in the several detailed accounts in the cost ledger, would very closely approximate the total values as above given in the general ledger, but if the percentage was widely different, then the inventory values, as derived from the cost ledger, should be increased or decreased so as to make them agree with the general books, or, if it is thought desirable to keep the cost ledger values as originally entered, for the purpose of charging them off at these values when they are transferred to other accounts, warehoused or sold during the following year, then the general books may be made to correspond with the cost ledger values by making a profit and loss entry to cover the increased or decreased valuations.

In a business in which a small amount of manufactured and partially manufactured material is carried, it will probably be better to let the cost ledger values remain as the inventory values for such stock as remains on hand, and make a profit and loss entry in the general books to cover the error of the original estimate of the percentage of manufacturing expense to be added to the labor cost of each article.

In this matter each factory will be a law to itself, and the system is susceptible of such modifications as will adapt it to the needs of different businesses and to the ideas of different bookkeepers.

The *Engineering and Mining Journal* has this hint to American stove and furnace makers:

For some years past American stoves and furnaces have enjoyed a wide popularity on the continent of Europe. Their graceful construction, effectiveness as fuel economizers, and low cost, have specially captured the thrifty German people. American-made stoves, certainly superior to the English and Irish-made stoves, have undersold them in the German markets, mainly because of the superior facilities and contrivances adopted in manufacture in this country. But the German objects to importing what he can make himself. Stove factories are, therefore, springing up all over, and more especially in the vicinity of Mannheim, where so-called "American stoves" are being turned out rapidly. The result of this has already appreciably affected the exportation of American stoves to Germany. And it may be depended upon that, as soon as the Germans perfect their mechanism and methods, and with cheap labor, they will become formidable competitors in our outside markets. In all the republics of South America, more especially, the Germans are now pushing their products, and in some cases they are even crowding the English. As our Teuton competitors waste little time in commercial matters, it behooves American stove manufacturers to watch their South American markets. Eternal vigilance and goaheaditiveness are the price of commercial supremacy.

The Railroad Gazette publishes an account of the railway accidents for the month of May, from which it appears there were 129 accidents of all kinds, in which 65 persons were killed and 140 injured. The number of collisions was 68, and derailments 56.

Force, Motion and Work.

By PEDRO.

THIRTEENTH PAPER.

MEASURE OF MATTER.

We have seen that in order to determine the force required to move a given body with some desired speed, we must know the quantity of matter that the body contains. Hence it is important to know how to measure matter conveniently. This, not only that we may be able to measure force, but because in every day's business affairs the value of some articles of commerce depends altogether upon the quantity of matter they contain, and not upon the volume.

The piece of platinum which represents the standard pound avoirdupois, the unit of mass, contains about $\frac{1}{13\frac{1}{12}}$ of a cubic foot of the metal. Hence if we were dealing only with the standard substance, platinum, we could simply divide the volume of the body in feet by the volume of the unit mass, $\frac{1}{13\frac{1}{12}}$, and the ratio would be the number of units of mass in the body. But all substances do not contain the same amount of matter in the unit volume, the cubic foot, hence mass cannot be measured by volume alone.

In foregoing papers we have seen that mass or weight is an element of force or the effect produced by it; hence, if we know the effect and the other elements we can measure matter by means of the force which produces a known effect. This is the method usually employed, and the force which is generally used for this purpose is that of gravity, because this is the most convenient and is always available. The operation of determining the quantity of matter in a body is termed "weighing."

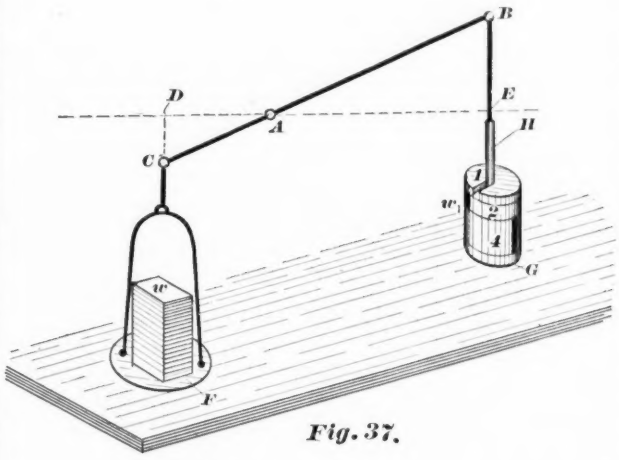


Fig. 37.

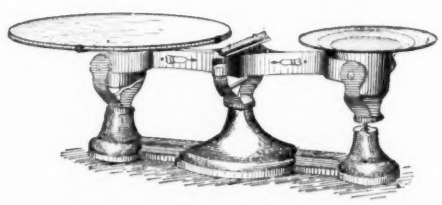


Fig. 38.

Fig. 40.

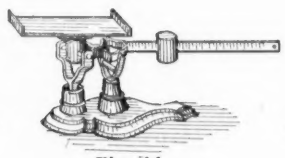


Fig. 41.

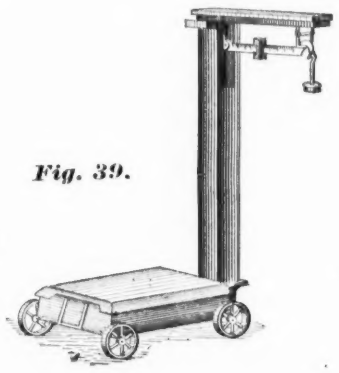


Fig. 39.

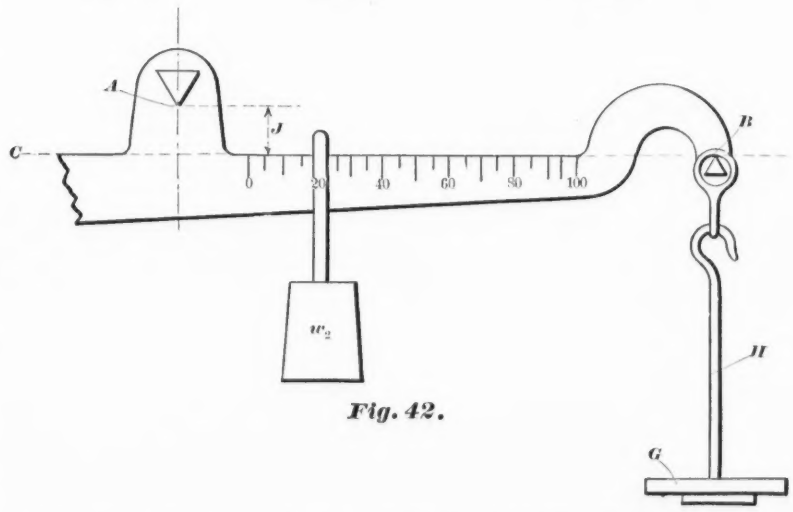


Fig. 42.

One method commonly employed is represented in Fig. 37, in its general principle. $C\ B$ is a lever supported at the point A, and is free to oscillate about the same. From one end, C, is suspended a pan F, upon which a body can be placed. From the other end, B, a rod, H, is suspended, having a disk G at its lower end, upon which "weights," as they are called, may be placed. These weights are generally made of cast-iron and sometimes of brass, and they are always proportioned or adjusted to contain a known quantity of matter as compared with the platinum standard. For example, in Fig. 37 the weight marked "1" contains one pound of matter, the same as the standard. The one marked "2" contains two pounds, twice that of the standard, and the lower one four pounds, etc. Now suppose that we add enough weights at G to elevate the body w, in the pan, through a height $C\ D$, and let w_1 represent the sum of all the weights added. Since $C\ A\ B$ is a rigid lever it is evident that the weights w_1 will be lowered at the same time a distance $B\ E$. By whatever force or forces this motion may be produced the effect produced in each case is, by Equation 35 $w \times C\ D$ and $w_1 \times B\ E$. If the weights w_1, are adjusted so that the lever $C\ B$ will come to rest in its horizontal position $D\ E$, then the two effects produced are equal, because, the force of gravity acting on each body in a downward direction, tends to rotate the lever $C\ B$, in opposite directions; that is, gravity acting on w_1 tends to rotate the lever in a right-hand direction, while its action on w tends to produce a left-handed rotation. When the effects are equal and opposite there can be no motion, for the one neutralizes the other, and the lever must, therefore, come to rest. Hence, when the weights are so adjusted that the lever will come to rest, then the effects or the forces are equal, and we have

$$w \times C\ D = w_1 \times B\ E.$$

Dividing both members of this equation by $C\ D$ we get

$$w = w_1 \frac{B\ E}{C\ D}$$

But the triangles $A\ C\ D$ and $A\ B\ E$ are similar, therefore, $\frac{B\ E}{C\ D} = \frac{A\ B}{A\ C}$, which, substituted above, gives

$$50 \ldots\ldots\ w = w_1 \frac{A\ B}{A\ C}$$

Now, the weight w_1 is known; also the lengths $A\ B$ and $A\ C$ of the lever; hence by making the calculations indicated we can find the weight of the body w, which is its quantity of matter sought.

If we had taken the forces instead of the effects, as above, we would have obtained the same result, since the force is measured by the effect produced in the unit of time, and the time of motion of w is the same as that of w_1. This method is used in the class of scales illustrated in Fig. 38.

The above method is sometimes slightly modified as follows: Instead of having a fixed length of arm, $A\ B$, Fig. 37, and adding weights at G until the force applied at B is equal to that exerted at C by w, the weight w_1 is made a fixed quantity and the length of the arm $A\ B$ is made variable. That is, the fixed weight w_1 is shifted along the arm $A\ B$ until a point is found where the effect produced on that side balances that on the other side, after which the arm length, $A\ B$, thus found, can be measured, and the calculations made the same as indicated in Equation 50. Fig. 41 illustrates this class of scales.

Both of these methods are used on the ordinary platform scales in common use; also on many other weighing scales. That is, the movable weights at G, Figs. 37 and 42, are used to measure 100., 200., 300., etc., pounds, while the intermediate weights—from 1 lb. to 100 lbs.—are measured by a fixed weight which is movable on the arm between A and B. To avoid the necessity of making the calculations every time that the amount of matter in a body is to be determined, these calculations are made by the maker of the scales and marked in a convenient place, where they can be read. For example, on the ordinary platformscales, Fig. 39, the ratio of the lever arms $\frac{A\ B}{A\ C}$ Fig. 37, is usually $\frac{100}{1}$, this ratio being obtained by compound levers; hence one pound at G, Fig. 37, produces the same effect as 100 lbs. on the pan F, according to Equation 50. Therefore the weight which indicates 100 lbs. at F is marked "100," but it really weighs only 1 lb. The "200 lb. weight" weighs only 2 lbs., etc.

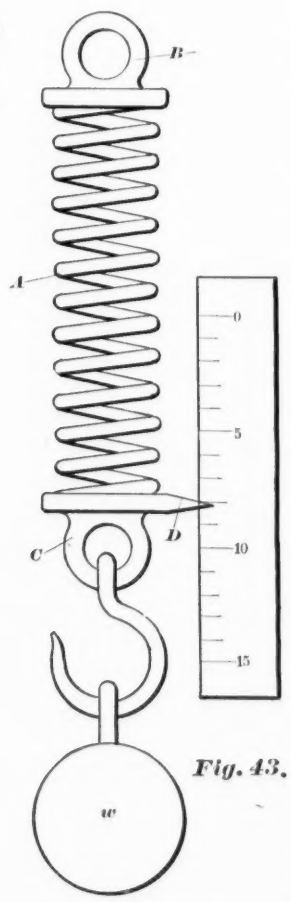


Fig. 43.

For any quantity of matter from 1 lb. to 100 lbs. on the pan or platform F, the calculations are made from the constant weight w_2, Fig. 42, and the distance of this weight, w_2, from the oscillating point, A, corresponding to a given weight on the platform, is marked to indicate the number of pounds there are on the platform F when the weight w_2 is moved to that point. That is, if the weight w_2 is placed on the mark "20" and it balances the body on the platform, then the weight of that body is 20 lbs. If in addition to this there are also some weights on the disk G, then these must be added to the reading on the "beam" $A\ B$ to obtain the correct weight of the body. Thus, if there is one 100 lb. weight and one 200 lb. weight on the disk G, and the weight w_2 must be placed on the "40 mark" on the beam to balance the body on the platform, then its weight is 340 lbs., which is the quantity of matter it contains. Figs. 39 and 40 show two forms of this class of scales.

On the ordinary commercial scale of this class, Fig. 39, there is no provision made for weighing anything less than one-quarter of a pound, but anything as small as .0025 of a pound can be accurately and conveniently weighed by *reversing the scale*, as it may be called. By this we mean that the article to be weighed is placed upon the disk G, Fig 37, and the standards or "weights" are placed upon the platform and weighing in the usual way, then dividing by 100. To make this plainer suppose the ratio of the leverage is $\frac{100}{1}$, as is usually the case on the ordinary platform scale, Fig. 39, then Equation 50 reduces to

$$51 \ldots\ldots w_1 = \frac{w}{100}.$$

That is, the weight of the article placed on the disk G is one-hundredth part of the weight on the platform F. As it requires a great deal of weight on the platform for a standard of comparison, the most convenient plan is for a man to use his own body as that standard. The process is as follows:

Place yourself upon the platform, Fig. 39, and weigh yourself in the usual way. We will suppose the weight is 140 pounds. Remaining upon the platform and placing the article to be weighed on the disk G, Fig. 42, weigh yourself again in the usual manner. Suppose the weight indicated this time is 125 pounds (not taking any account of the article placed with the weights). Now take the difference of the two weighings and divide by $100 : \frac{140 - 125}{100.} = 0.15$ pounds $= 0.15 \times 16 =$ 2.4 ounces. This is the weight of the article desired. Most of these calculations can be made mentally, hence in actual practice very little more time is required than in the ordinary way of weighing.

As shown in Fig. 37, the two points of suspension C and B and the point A, upon which the lever oscillates, are located on the same straight line. In practice, scales are not so constructed, because the beam would not necessarily come to rest in its horizontal position D E, but it would remain in any position it might be placed when balanced. Fig. 42 shows the proper form of construction. The point of oscillation, A, is located a little above the line of suspension C B, as shown by the distance J. By this manner of construction the beam will come to rest only in its horizontal position when the forces acting on the ends are equal. In order that the weight of the material of which the different parts are constructed shall have no influence on the quantity of matter to be determined, the parts must be so adjusted that the beam will be at rest in its horizontal position when there is nothing upon the platform and no weights on the disk G, and the weight w_2 is at its zero mark.

Fig. 43 represents the principal parts of another form of weighing instrument or machine. This is generally known by the name of *spring balance*. It consists simply of a helical spring, A, usually made of round wire. At its ends are attached some eye-pieces B and C, the instrument being suspended from the upper one, B. The lower one, C, supports a hook from which any body w may be suspended. The instrument is provided with a scale as shown, and a pointer D. When any body whose weight is to be determined is suspended from the hook the mark at which the pointer stands indicates the weight of the body. The scale may be marked as follows: First make a mark to correspond with the pointer when there is nothing on the hook. This will be the "zero mark." Then take a standard weight of one pound and suspend it from the hook and again make a mark opposite the pointer; this will be the "one-pound mark." Repeating the same operations with a two-pound weight gives the "two-pound mark," etc., until the scale is completed. When the elasticity of the spring is uniform, all the "pound marks" may be laid off equal to the first one after that has been determined. The pound spaces may then be subdivided equally as desired.

Now any body hung on the hook, having the same amount of matter as the standard, will deflect the spring the same amount, since the same force will always produce the same effect on the same quantity of matter, hence the weight of any body will be indicated on the scale. This is only one of many modifications in the construction of spring balances.

There is a great variety of other forms of weighing machines, but the two classes explained suffice to give a correct idea as to how the quantity of matter in a body is determined.

The quantity of matter in any body may also be ascertained from its volume when we know the *density* of the substance of which the body is composed. The density of any substance is the quantity of matter or weight in a unit volume of that substance. Therefore the weight can be obtained by multiplying the volume by the density, that is, if D_0 represents the density and V_0 the volume then

$$52 \ldots\ldots w = V_0 D_0.$$

There are tables published in various books giving the density of various substances.

There are other instruments which are known as dynamometers (force-measuring instruments), which are used to measure forces in general. These are generally constructed on the principle of the spring balance. The forces are also measured in "pounds," because matter is a measure of static force (Rule 47, twelfth paper). That is, matter and static force are the same in quantity. We say the same "in quantity" because they are not the same physically, for we have seen in the twelfth paper that force is measured by three dimensions, which are called the elements of force—foot-pound-minutes or gravity-pound-minutes. Weight or matter is one of these elements; but, since the other two elements are unity in the static force, the number of units in the force acting on the body and the number of units of matter are the same. Hence the weight of a body gives the number of units (pounds) of force with which the body is attracted by the earth, since the motion generated by gravity in the unit of time is taken as the unit of space in measuring common or gravity force. This unit was probably adopted because we can get an idea of the intensity or the amount of pull of a unit force by lifting one pound of matter against gravity.

The steam engine indicator is a familiar example of one form of dynamometer.

LETTERS FROM PRACTICAL MEN.

Cut-off Indicator.

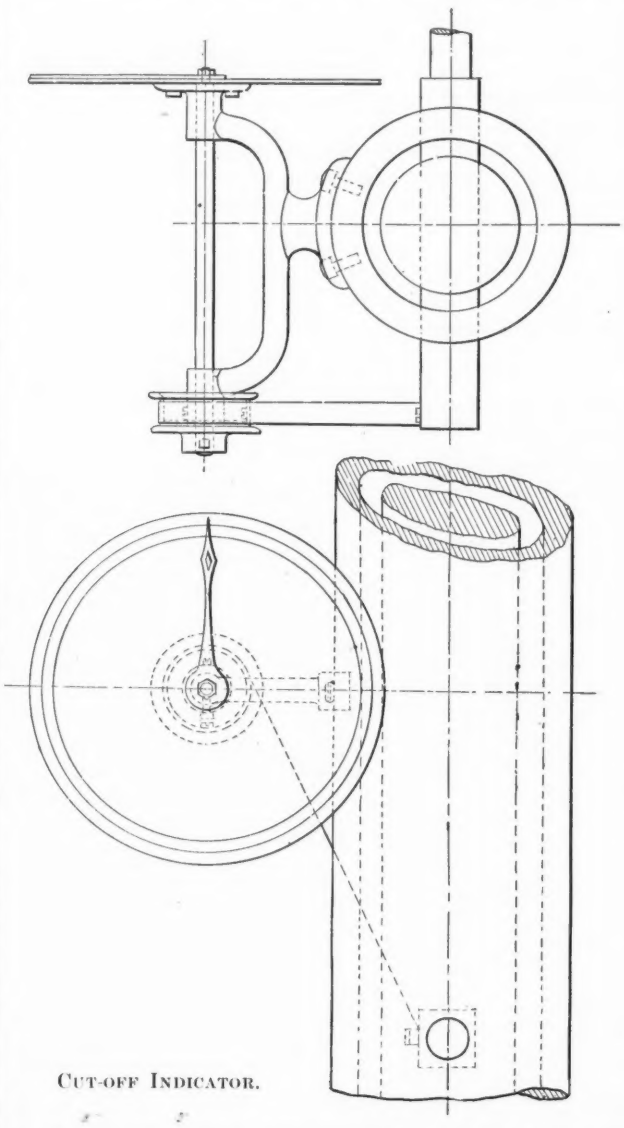
Editor American Machinist:

Jonson has a new wrinkle on his Corliss engine, and I take pleasure in presenting it to the fraternity. The fact is, Jonson is always scheming, contriving, studying new and better ways to do things, and then calls me in to show off the points. On the whole, the results are very good for me, dispelling all tendencies toward mechanical somnolency, and leaving one in the condition of a baseball club after a full dose of an exotic termed "ginger."

This wrinkle he calls a cut-off indicator, and is attached to the governor column. A bracket of cast brass, with hubs at opposite extremities, is fastened to the column (see cut), and a shaft passes through the hubs. A brass dial-plate is attached to the enlarged end of one hub by screws, and the shaft projects through the plate far enough to receive a needle and its lock-nut. On the opposite end of the shaft is a small pulley, held by set-screw, and partly bored out so as to receive a light return spring. A narrow strip of steel, .004 inch thick, is soldered to the face of the pulley, one lap taken around it, and then fastened with a screw to the rod leading to the governor dash-pot.

The pulley is revolved directly as the total lift of the governor, which is 4.5 inches, while the circumference of the pulley is 4.71 inches. Therefore the shaft cannot make a full revolution. The dial being 5.5 inches diameter, its needle is 2¾ inches, while the radius of the pulley is ¾ inch, the travel of the former to latter being directly as 2¾ is to ¾.

Now, Jonson argues thusly: The speed is a constant, and assume the pressure to be a constant, then a constant × a constant = a constant. Therefore, if the boiler pressure can be constant, a given point on the dial, indicating a given cut-off, proven by an indicator, will continue to show the same cut-off. Every steam plant aims to hold its boiler pressure constant, yet allowing a variation in pressure, Jonson has provision for this, when the variation amounts to say five pounds. Assuming the outer edge of the dial graduated for 100 pounds, then the next inner circle for 95 pounds, leaving the third circle, if necessary, for 90 pounds. Reading the steam gauge one can instantly see which circle to read. However, with his well trained fireman the pressure is practically constant. The graduation was accomplished with the aid of a Tabor indicator. The return spring, not shown in cut, is fastened to the hub and pulley, and is just sufficient to do the work required of it. Should the trip-rods be unequal, allowing one end to cut off earlier than the other, the result is shown by the needle.



CUT-OFF INDICATOR.

The device presents a very neat appearance, is not subject to any wear, and is, I believe, original with my friend. Having no intention of patenting it, any one is at liberty to use it. Nicely constructed, it will not add any appreciable friction to the governor, and, so far as I know, it has no objectionable features, while its advantages will be apparent.

DUPLEX.

Temporary Follower—Repair of Cone Pulley.

Editor American Machinist:

In your issue of July 2d, "A Mechanic" describes a "follower rest" that appears to be a good one, and shall probably try one on the same plan before long.

A short time ago, having a chuck screw to chase (which was 15 inches long), and knowing that a 5-thread would spring it considerably near the center, I made a temporary follower rest which answered the purpose admirably, allowing a good cut at rather fast speed, and no sign of a chatter or spring anywhere.

A block of hard wood A was procured of the right size to span the dovetailed way in carriage, and rest firmly on each side, and of right height to come even with lathe center, as shown in Fig. 2. Then a piece of 1¼-inch maple (3 by 4 inches in this case) was procured and fastened on square with the screws T T to hold it square with the block while moving when necessary.

A ⅝-inch hole through both and a $\frac{5}{16}$-inch bolt reaching through and screwing into the iron plate c, shown in Fig. 1, about completes the rig.

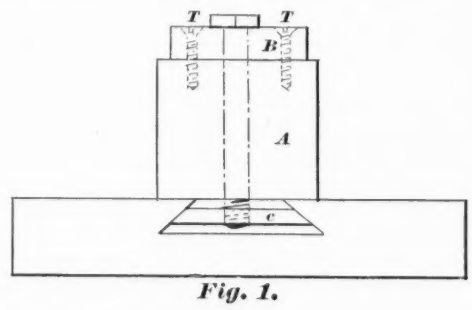


Fig. 1.

I set it square by the tool block, and then fasten the rest in place.

Then a small "hook tool" was put into the drill chuck and run at fastest speed, and the block fed slowly along by moving carriage; the "hook tool" was of the right radius for the screw to be cut, and fitted

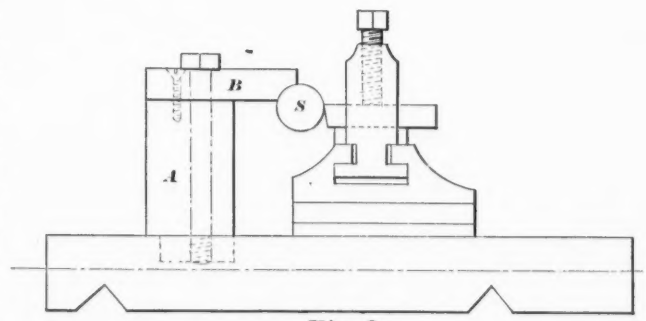
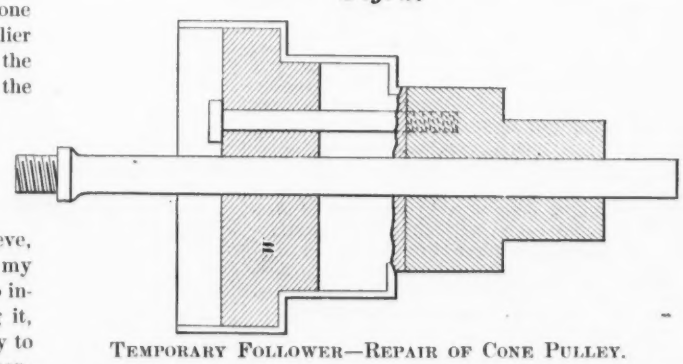


Fig. 2.



TEMPORARY FOLLOWER—REPAIR OF CONE PULLEY.

splendidly, as shown in Fig. 2. The maple showed very little wear, and held the screw firmly all through the cutting, making a neat job and saving time by allowing a faster speed and heavier cuts. By using maple or any other hard wood a bushing is unnecessary, as it will not cut or scratch the work in the least—at any rate that was my experience, and intend making a permanent "follower rest" some day, and may use a hard wood bearing there in place of a bushing of metal. As my figures of the block show (3x4 inches), the bearing on work was three inches long, and that probably held it more steady than a narrower one; it is a cheap rig, and may be of use to some reader of the AMERICAN MACHINIST.

I had occasion to repair a speed lathe "cone" the other day, and will show how it was accomplished.

It was a "four-speed" cone for a two-inch belt, and was broken almost evenly in the middle, right at the forward end of the second corner. It broke "roundways," leaving the two smaller cones in good order, and it was run with these for some time until a chance came to repair. The cause of breakage was that a master chuck had been forced on so tight that it could not be loosened save by heating or "jarring," and it was being "jarred" on the anvil when the larger part of the cone said good by to its smaller neighbor and dropped off. The smaller cone had a web or spider inside—three spokes in this one—and these were drilled and tapped for half-inch bolts.

A block of wood *W* was then turned up to fit inside the large size cone, and shoulder on the step in the cone, as shown by the drawing; bolts of the required length being put through the block, and screwed into the inside spokes. The block of wood drew the loose part of cone to place, and there it is running to-day, as good as new, and will not break as easily as before.

While speaking of repairs, I cannot help recalling a remark made by a foreman in a brass shop near me, and this is what he said: "I have a good tool maker, makes good tools and works well, but he hates repairs, and neglects them most shamefully; says he forgets them; now what can I do?"

I told him that probably the man did forget some of it, for I know it isn't always the easiest thing to remember just what tool needs fixing, or, what is harder, to think of it at an opportune time, when there seems to be a good chance for such work.

Sometimes we use a tool to finish a job even after it is a little out of repair; it may work well enough and still not be first-class, and if this is put away with the rest of the tools it is easily forgotten. I told him of a plan I've used for quite awhile—can't tell just how long, but it works first-class.

I got a cheap blank-book and fastened a pencil to it, leaving string enough to use it freely, and keep it near me in the tool-room.

When I am told of a tool being "out of gear," I write it down, with the date at one side. When, on looking over the tools, calipering and measuring, I find anything worn or broken, down it goes, and so on; everything that needs fixing that there isn't time for then, and whenever a new scheme for some tool or other presents itself, it is noted.

The cover of the book says "Odd Jobs," and whenever a lull in new work gives time for such repairs, or when some tools on the list are likely to be called for, I consult "Odd Jobs," and go to work.

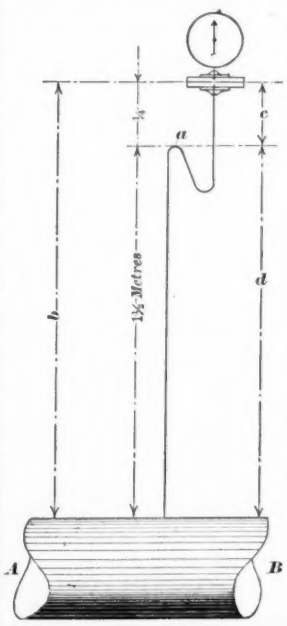
When the tool is repaired, or work done, as the case may be, I put the date below the first date, and put an R on the item, so that an old item looks like this—

Repair sizing bar for No. 6, 1, 9, '90
R 2,11, '90

Don't get a good blank book or you'll be afraid of soiling it, but get a cheap "yellow" paper book so you can write what you wish to without stopping to wash your hands every time; if you wait for that you will miss half your items.

I am sure there must be many tool makers, machinists and mechanics of different branches, who, like myself, are interested in the developments of electricity from a mechanical standpoint as well as electrical.

We are liable at any time to be called upon to tackle a dynamo or motor, to repair it perhaps, perhaps to have charge of one in an isolated plant, and there are few of us who would like to admit that we couldn't, yet most of us would be compelled to, I think.



ERRORS IN GAUGE PRESSURE.

Now there must be some who have studied the "slippery stuff" at leisure moments, and some who have a little apparatus of their own, battery, magneto, perhaps, or some other small arrangement that helps any one to understand the eccentricities of the electric current.

Many engineers see the AMERICAN MACHINIST, and surely some of them have charge of a small plant, and could give the novices who are trying to understand it many points that would clear existing mysteries.

I am sure the editor will give space to any useful articles on the subject, and they would be highly appreciated by many of the readers. FRED H. COLVIN.

Errors in Gauge Pressures.

Editor American Machinist:

Some time ago, having to make some tests in collaboration with some foreign engineers, which involved the testing of water pressures in a pipe, as *A B*, I found the arrangement as in the figure of pressure gauge. In entering up the gauge readings I booked the actual reading plus the height *c*. My colleagues entered the gauge reading plus the height *b*, for, said they, the vertical pipe is full of water. This I did not myself believe, for I could not see how, when the large pipe *A B* was alternately full and empty, water could remain in the vertical stem of the gauge pipe. To test the matter a small hole was drilled at *a*, and on every occasion when the flow was freshly started there was always a quantity of air passing along the pipe, and invariably a jet of air issued at *a* for a long time after the trial commenced. This proved conclusively that in every case the vertical height *d* was always full of air and the true reading was the gauge reading plus the height *c* only.

When the pressure in *A B* was considerable—half an atmosphere, for example—the pump supplying the water would begin to work solid water only, and a jet of water would issue at *a* after a time if the plug were removed. In that case, of course, the height *b* would require adding to the gauge reading; but had the plug not been removed air could not have escaped and the true reading would never be more than the gauge reading, plus *c*.

Such arrangements of gauges are liable to give rise to discrepancies and even disagreements, and should be avoided if possible.

When obliged to be put up with, means should be taken to insure truthful reading by testing if air is continually supplied or not, so as to ascend the stem of the gauge and keep the water out. Air creeping along the crown of the pipe under pressure readily escapes up any available opening.

Somewhat similar errors are sometimes liable to arise with boiler gauges. I have seen the gauge of a boiler connected to the boiler of a long pipe which was first carried vertically upwards from the steam space and then downwards as much as 12 or 15 feet to the foot of the gauge—a mercury column. The gauge would thus read 6 or 7 pounds more than the true boiler pressure, for the down leg of the pipe would always be full of water. The smallness of the pipe probably accused it to be unheeded, but of course a small pipe, unless within the range of capillary action, has just as much hydrostatic effect as a large one, and cannot be neglected.

Though in this latter case the error was on the safe side, it is within the possible that an error in the opposite direction might be similarly brought about, and such causes of error need looking for and avoiding. In the case which called my attention more particularly to the matter the error caused would amount to something like 16 per cent.

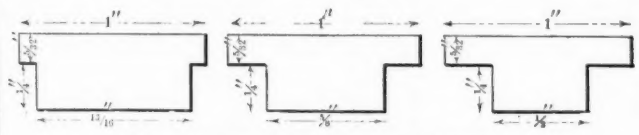
W. H. BOOTH.

Making Fixtures Fit any Machine.

Editor American Machinist:

Here is a point of shop practice which I think is new, and will be of use to many readers. In designing milling and planing fixtures, the question often used to come up, *Which machine will this fixture be fitted to?* the question arising from the fact that each milling machine and planer may have a different sized width of slot in the table. This question has been satisfactorily answered at John Royle & Sons, Paterson, N. J., by making the slots in all the fixtures of one size, say 1″ wide, $\frac{5}{16}$″ deep, and furnishing each milling machine and planer with a pair of tongue blocks shaped as below. Supposing, for example, the sizes of slots in tables of the machines considered being $\frac{13}{16}$″, $\frac{5}{8}$″ and $\frac{1}{2}$″.

These blocks tap lightly into the slots of the machine table, and the projecting part, 1″x$\frac{5}{32}$″, allows any fixture in the shop to be placed on the table of any milling machine or planer in the shop, and lined up. Other advantages of this system will be apparent to those interested. GRANT SIPP.



MAKING FIXTURES FIT ANY MACHINE.

A 61 Tooth Gear.

Editor American Machinist:

Some time ago a fellow machinist made inquiry of me as to how he could cut a 61 tooth gear on the B. & S. milling machine. At the time I told him as it was a prime number, it couldn't be cut, either in the regular way or by the differential method, unless a circle of 61 holes was employed.

Lately, however, an idea occurred to me by which any number of teeth may be cut, not theoretically correct, but near enough, perhaps, for all ordinary purposes, and this without making any additional rigging. Thinking that perhaps it was one of those things that look all right on paper, but don't pan out very well in practice, I cut a 61 gear of 64 pitch, and it worked as smoothly as though i had been cut in the orthodox way. The method I used was this: I set the index head as though I were cutting 60 teeth, set the cutter one-half of the circular pitch off center, and then after each cut moved the cross-slide one-sixtieth of the circular pitch. The circular pitch equivalent to 64 diametral pitch is approximately .049, one-sixtieth of which is a little more than .0008. If we move .0008 each time the sum of the 60 moves will be .048. We can get in the extra .001 by moving .0009 on every sixth tooth instead of .0008, and thus divide the error up so that it won't appear all in a bunch where we stopped. Of course the movements of .0008 may be estimated closely enough, but it is necessary to see that the sum of all the cross slide movements is just equal to the circular pitch. It is necessary, also, to pay attention to the direction in which the gear wheel blank rotates. If the index head is set for the next lower number of teeth, the top of blank must move in the same direction as the cross slide is moved, to get the difference of the two moves; but if the head is set for the next higher number, then the top of blank must move in the opposite direction to that of the cross slide, in order to get the sum of the two movements.

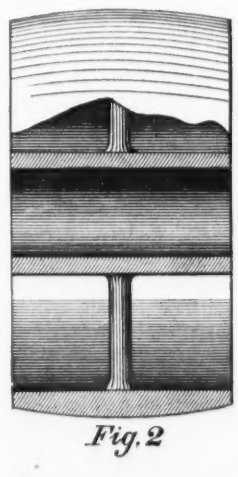


Fig. 2

If the nearest number for which we could set the index head differed from the desired number by 2, then the cutter would be set the whole of the circular pitch off center, and the cross slide movement would be twice the circular pitch divided by the number for which the index head was set.

The first and last teeth cut will lean toward or from each other a little, but not to any great extent, except on low numbers, and we would never have occasion to use this method on any number less than 50.

WALTER GRIBBEN.

The Stove of the Future.

"That looks neat," was the remark to the stove man. "What is it?" "It is the new gas stove. The day will come when all the world who can get at it will want to do its summer cooking by gas, and maybe its winter cooking as well. This stove, you see, has burners for all the stove-holes and two ovens. It adm'ts air into the gas at the point of combustion and makes a bunsen flame of each. We ran all the burners full blast for two hours the other day, having the meter taken before and after, and it cost exactly 12 cents. We can raise a kettle of cold water to boiling in seven minutes, and all you have to do is touch a match to the gas and your fire is going. Handsome, too, isn't it? Looks like a stylish fancy range."
—*Lewiston Journal.*

A New Loose Pulley Oiler.

The accompanying illustrations show the construction of a loose pulley oiler, which embodies some new features, notably the one which allows an old pulley which has become worn to be used without any change whatever, except boring out larger to admit the sleeve by which the oiling is accomplished.

Fig. 1 shows this sleeve in place on the shaft, *A A* being the oil chamber, which is filled by removing the small screw at the top *E*, and secured to the shaft by the larger screw *e*. *B* is the feeding wick, and *c* a channel for dirt or other foreign substances. The felt wick used for feeding is fitted to a channel cut in the sleeve for the purpose and, of course, it will readily be seen how the oiling is accomplished. Where both the pulley and shaft are badly worn this sleeve can be put in by simply boring the pulley, the bearing surface of which is thereby increased. A number of these oilers have been in use for a sufficient length of time to prove their value. They are made by E. & F. Gleason, Philadelphia.

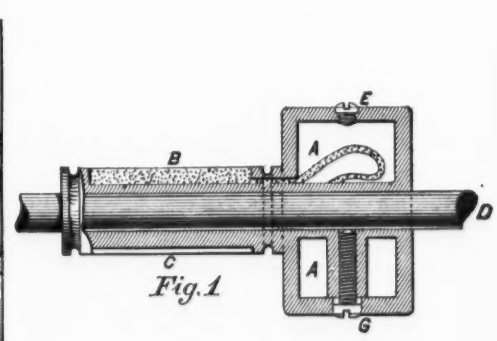


Fig. 1

LOOSE PULLEY OILER.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
96 FULTON ST., NEW YORK.

PUBLISHED WEEKLY AT
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

Subscription.

$3.00 a year in advance, postage prepaid in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
BREAM'S BLDG'S, Chancery Lane, LONDON, E. C., ENG., will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington NewsCompany, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, JULY 17, 1890.

CONTENTS.

PAGE.

Universal Sawing Machine..... 1
Hints on Jig Making. By Wendell Willis..... 1, 2
Odontics, or the Theory and Practice of the Teeth of Gears. By Geo. B. Grant..... 2, 3
Separators and Reheaters..... 3
A Factory Cost System. By William Kent, M. E. 4, 5
Force, Motion and Work. By Pedro..... 5, 6
Letters from Practical Men: Cut-off Indicator. By Duplex—Temporary Follower—Repair of Cone Pulley. By Fred. H. Colvin—Errors in Gauge Pressures. By W. H. Booth—Making Fixtures Fit any Machine. By Grant Sipp—A 61 Tooth Gear. By Walter Gribben..... 6, 7
The Stove of the Future 7
A New Loose Pulley Oiler..... 7
Regarding Boilers..... 8
The Term "Calorimeter"..... 8
It is Manufactured Ice..... 8
Questions and Answers..... 9
Manufactures..... 9, 10
Heating and Lighting Passenger Trains..... 10
Practical Details of Blacksmithing. By B. F. Spalding..... 10
Where Newspapers are Appreciated..... 11
Self-Adjusting Pliers..... 11
Machinists' Supplies and Iron..... 12

Regarding Boilers.

It has long been known among those who have had opportunities for judging of the matter, that the business of making and selling boilers in this country, taken as a whole, was in a deplorable, not to say disgraceful state. This fact has been as well recognized by the intelligent and better class of makers of boilers as by engineers not interested in their manufacture or sale. It is perfectly well known that boilers have been and still are made of materials known to be entirely unfitted and unsafe for such purposes, and in many cases this poor material is supplemented by workmanship which is, if possible, worse. It is perfectly safe to say that, if every citizen could be made to understand the real danger to life and property caused by this combination of poor, and often second-hand materials, with the criminal carelessness or absolute ignorance shown in design and workmanship, the very name of a boiler would become a terror, and laws would speedily be passed securing some sort of regulation, and fixing a standard below which no boiler manufacturer would dare go.

This state of things is due to several causes, and among others ignorance plays an important part. There are those who have never taken any trouble whatever to inform themselves of the nature and magnitude of the stresses brought upon boilers, and who are quite apt to say, when danger is alluded to, "Oh, they can't blow up as long as there is plenty of water in them." Talk to such a man about a boiler being the same as any other structure designed to bear stresses for which it must be calculated and adapted, and he scoffs at you, and possibly tells you how many years he has been in the business, as though mere years, without thought or the least effort to become acquainted with the nature of the forces dealt with, were all-sufficient.

But while ignorance plays an important part in the matter, what is euphemistically called the commercial consideration plays a much more important one. Men who know perfectly well how a boiler should be constructed, construct many of them in a manner and out of material which they know ought not to be allowed; but they say they "must do it or go out of business. The public neither knows nor cares anything for good boilers, and will not pay for them." They "simply supply the public with what it demands and is willing to pay for." Of course comparatively few of these boilers are sold for what they really are, and most of those who buy them are incapable of judging between good and bad in boilers, so that there has been little effective check on the business of making and selling them.

Some boiler manufacturers who desired to do good and honest work, and wanted to secure a fair chance for doing it, organized, about a year ago, an association called the American Boiler Manufacturers' Association, with the idea of getting as members practically all the manufacturers of boilers in the country, who should pledge themselves to use nothing but the best materials and workmanship for boilers, and to do whatever else seemed practicable to bring about a better condition of affairs, including the fixing of a scale of prices which should at least allow of good boilers being built.

This association is, of course, necessarily possessed of a two-fold nature; *i. e.*, it is in a sense an engineering society, but in another sense it is a business association, organized for purely business reasons, and with business purposes in view. It was recognized from the first that this feature would cause many complications, both in the organization and future management of the association, but it was hoped that no serious consequences would result from it. There is still room for such hope, though there is little room for doubt that a crisis in the history of the young organization was reached when it took up the matter of the organization of a boiler inspection and insurance company, at its recent meeting in New York City. The result of this move will be watched for with great interest by the friends of the association who had hoped, and still hope, that it may yet be the means of bringing about a condition of affairs in which it will be very difficult for any one to make and get into use a boiler not properly made, or made of dangerous materials. Not all the members of the association will desire to take stock in the insurance company, and it is not unlikely that those who do take stock may at some time or other object to non-stock-holding members having any voice in the affairs of the insurance company, while, on the other hand, it is probable that these non-stock-holding members may object to the association fathering or being in any way responsible for the insurance company, unless all members of the association are to have a voice in the direction of its affairs. Members who hold stock, and those who hold none, are bound, human nature being as it is, to take different and probably irreconcilable views upon matters of policy.

And of course the more things there are connected with such an association about which the members may differ in opinion, the more difference of opinion there will be, and the more danger of discord and lack of that harmony which is essential to success in any association. Much of this danger could have been avoided, had those who wished to form an inspection and insurance company formed it upon their own responsibility, restricting the ownership of stock to persons actually engaged in the business of boiler manufacturing, or even to members of the association. This no one could have objected to upon reasonable grounds, and if for any reason the venture had proven unfortunate, as of course all business ventures are liable to do, the association would have been unaffected thereby.

Still we do not wish to be understood as prophesying evil from this move. We only wish to call attention to the fact that the difficulties presented for solution in the formation of such an association have undoubtedly been increased to some extent at least, though we hope the result will well repay the effort necessary for overcoming them.

It is an undoubted fact that, if all or nearly all boiler manufacturers in the country should join the association, and strictly adhere to the resolution pledging the members to the use of the best materials and workmanship, that of itself would result in great benefit to the business, and for the sake of boiler manufacturers generally, and of the public, we wish that this might be done.

There are boiler manufacturers, both inside and outside of the association, who know what a good boiler is, and who will not permit any other kind to go out of their establishments. We hope some way will be devised by which these men may be relieved of the unfair competition of the other kind.

The Term "Calorimeter."

A recent number of *Engineering* devotes nearly a page to a review of a new book upon "Steam and other Prime Movers," concluding a severe, though probably well-deserved criticism, with the words, "We condemn this book as one which can hardly, under any circumstances be of use, but which is, on the contrary, almost certain to do great harm to any student who attempts to obtain from it help in the study of the steam engine."

One paragraph of the review condemns what it calls a most extraordinary use of the word "Calorimeter." It says, "A calorimeter is generally understood to be an apparatus for measuring quantities of heat, but Dr. Evers appears to think it means an area; for we have the 'calorimeter over the bridge,' and 'calorimeter through the tubes, etc., all given relative to the grate area of a boiler. Had the term appeared once only, it would be natural to suppose it a printer's error, but finding it repeated no less than four times, we can only conclude that it is really put down as representing an area."

The writer of the review is apparently not familiar with American engineering literature, or he would not have been surprised to see the word calorimeter used to represent an area.

We think the first author to use the word in this sense was Chief Engineer B. F. Isherwood, of the U. S. Navy. In his "Experimental Researches in Steam Engineering," Vol. II, preface, p. lxxxv, he says: "The evaporative efficiency of a boiler of a given type is found, experimentally, to be governed, *ceteris paribus*, wholly by the proportion of its calorimeter, and of its heating surface to its grate surface. By calorimeter is meant the aggregate cross area of the fire-tubes or flues, due to their inner diameter, and [in a water-tube boiler] the aggregate cross area between the water-tubes."

Since 1865, the date when "Experimental Researches" was published, numerous other writers on steam boilers have used the word calorimeter in the same sense. A recent instance of it is in the paper on "Chimney Draught," by Prof. H. B. Gale, read at the New York meeting of the American Society of Mechanical Engineers. Since that date, also, the apparatus known as a calorimeter has been very generally used in connection with boiler tests, for the purpose of determining the amount of moisture present in the steam, or the amount of superheating, by measuring the quantity of heat which the steam contains. The word is in this case used correctly, according to its etymological significance "heat measurer." It is certainly not correctly used to express an area, and it is unfortunate that it was used in this sense by such an authority as Isherwood, and that such use has been perpetuated since by so many writers.

The criticism of *Engineering* would indicate that the word is not used by engineers in England to mean an area, and it is to be hoped that, for the sake of pure English, and especially to prevent confusion in the use of engineering terms, that its use in this sense will be discontinued by American writers.

It is Manufactured Ice.

The Boston purists have broken loose again, and are protesting vigorously against the term "artificial ice." They assert that the product of the ice-making machines is "ice"—neither "artificial" nor "imitation" ice. Guess they are about right; yet how is the stuff to be distinguished by name from "natural ice"? The term "machine ice" seems to meet the case, for "manufactured ice" would apply equally to that produced by human agency or by natural process. It will be a cold day when Boston finds nothing to carp at.—*Newark News.*

Well, it seems to us that the so-called "Boston purists" are right, and, moreover, that there is use in "carping" at an incorrect and misleading use of terms. Ice made by machinery is not artificial ice, but genuine natural ice. And, on the other hand, we would like it to be explained just why "manufactured ice" is not correct, or how that term could be applied to ice frozen by nature. The original etymological meaning of the term "manufacture" was to make by hand; but, as hand processes were supplanted by machine processes, the term has come to be applied to the process of making things by human agency, whether by hand or machine, and there is no other authorized use of it.

Manufactured ice is therefore correct, and the term would not apply to ice made as a result of the sun's southern declination.

The reports which reach us through the English technical journals regarding the Board of Trade inquiry into the City of Paris accident fully confirm the opinion expressed at the time, that the accident was caused by the phenomenal wearing of the lignum vitæ strips in the bearing just forward of the screw, letting the shaft down so that the excessive strain caused it to break. The owners of the vessel gave every possible facility for a full investigation, and there is little doubt that, owing to the unusual interest taken in the matter, the investigation has been of the most thorough and comprehensive character. The value of the twin screw principle has been illustrated by this investigation in a new and probably unexpected way. It happened that the method of secur-

ing the lignum vitæ strips to the bearings in this case was comparatively new, and this would undoubtedly have been severely condemned by some who would have pointed out why it could never be successful, and ought not to have been used, had it not been for the fact that another bearing of precisely the same kind, and which had been subjected to precisely the same usage, was on the other side of the vessel and was in excellent shape.

Altogether, the owners of the vessel, and the public of both countries between which she plies are to be congratulated upon the manner in which she has come through the trial. There is probably no better or safer vessel afloat.

QUESTIONS AND ANSWERS.

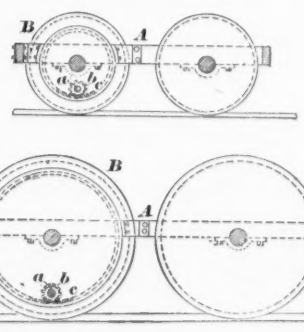
Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(277) X. Y. Z., Mechanicsburg, Pa., asks: What are the objections to slotted crossheads for converting reciprocating into rotary motion? *A.*—They subject the piston rod to a compound stress, and are liable to produce fracture.

(278) A. R., Philadelphia, Pa., writes: Please give me the names of some good books on gears, giving the calculations and proper way to make nice shapes. *A.*—The series of articles on gears by Geo. B. Grant, now running in the AMERICAN MACHINIST, will give you the desired information.

(279) C. W., ——, N. J., asks: Can you tell me the height of the highest smokestack in Lancashire, England? Or is there any over 335 feet high? *A.*—We have no complete record of the height of chimneys in England. You will find the height of some of them given in our issue of June 19, current volume; they exceed 335 feet in height.

(280) C. H. F., Boston, Mass., writes: I enclose herewith, sectional drawings of two trucks, one having much smaller wheels than the other, as shown. These trucks are designed to be propelled by an electric motor (not shown), this motor is to be bolted to the web of the truck wheels *B*, and its armature secured to the shaft *a*, the bearings of which are cast on the web of the truck wheels *B*. Secured to the shaft *a* is a pinion *b*, which is always in mesh with the internal gear *c*; this internal gear is bolted to the truck frame *A*. This distance from rail to center shaft *a*, when in the position shown on the drawing, is the same in both trucks. The inventor claims that it requires no more power to drive one truck than the other. I maintain that less power will drive the small truck than the large one (both having the same load to carry, including the weight of the



truck), for the reason that the center of the truck wheels is nearer the shaft *a* in the small truck, and consequently the shaft *a* will have a greater leverage. Am I right? *A.*—You are wrong. It seems to us that you have made a mistake in writing; we cannot perceive how you could have arrived at the conclusion that the leverage on the small truck wheels is greater than on the larger ones, for the reverse is the case. The power of a machine is the energy exerted in some interval of time of definite length, and does not mean the force expended in performing the work. The unit of power is the number of foot-pounds of work that can be expended in a unit of time, whereas the unit of force is simply pounds. Looking at the meaning of the term "power" in this light, then both trucks will require the same amount of power to drive them, provided the friction is the same in both cases; in fact, the large truck will, we think, require somewhat less power, because the large wheels will run over small obstacles on the road with greater ease than the small wheels. The ratio of the diameter of the small wheel and the diameter of its internal gear is greater than that of the wheel and internal gear in the large truck, and on this account the latter truck will require a smaller force to drive it; but the power, except as above noted, will be practically the same in both cases.

(281) W. D., Brooklyn, N. Y., writes: Please answer the following questions, to decide an argument: 1. The kind of iron used to manufacture malleable iron. 2. The proper degree of heat required to make toughness; and kind of ovens used in manufacturing. A. Malleableized cast-iron, or malleable cast-iron and steel castings, are castings made originally of ordinary cast-iron, which have been subjected to a process of decarbonization which results in the production of a crude wrought-iron. The process is conveniently applicable only to small castings, although pieces of considerable size are sometimes thus treated. Handles, latches and other similar articles, cheap harness mountings, plowshares, iron handles for tools, wheels and pinions, and many small parts of machinery, are made of malleable cast-iron, or as steel castings. For such pieces, charcoal cast-iron of the best quality should be selected, in order to insure the greatest possible purity in the malleabl product. The castings are made in the usual way, and are then imbedded in oxide of iron, in the form, usually, of hematite ore, or in peroxide of manganese, and exposed to the temperature of a full red heat for a sufficient length of time to insure the nearly complete removal of the carbon. The process, with large pieces, requires many days. The pig-iron should be very free from sulphur and phosphorus. The best makers have usually melted the metal in crucibles having a capacity of 50 to 75 pounds, keeping it carefully covered to exclude cinder and other foreign matter. The furnace is similar to that of the brass foundry, from two to two and a half feet square, and the fire is kept up by natural draught. The temperature is determined with sufficient accuracy for the practical purposes of the founder by withdrawing a portion on an iron bar. If hot enough, the drop burns on exposure to the air. If right, the metal is poured quickly. The "cementation," or decarbonization, is conducted in cast-iron boxes, in which the articles, if small, are packed in alternate layers with the decarbonizing material. As a maximum, about 800 to 1,000 pounds of castings are treated at once. The largest pieces require the longest time. The fire is quickly raised to the maximum temperature, but at the close of the process the furnace is cooled very slowly. The operation requires from three to five days with ordinary small castings, and may take two weeks for large pieces.—*The Materials of Engineering*, by Prof. R. H. Thurston.

(282) M. P., Buffalo, N. Y., writes: Please give me the rules in plain language for solving the following problems. How much power will a one-inch double belt transmit under the following conditions? The shaft is $\frac{15}{16}$-inch diameter, 3 feet long; length of bearings 4 inches, babbitted; diameter of pulley 18 inches; number of revolutions 60 per minute. *A.*—For finding the horse-power which a double belt will transmit we have the following formula:

$$H = \frac{D \times R \times W}{1{,}925},$$

in which H denotes the horse power that can be transmitted by the belt; D, the diameter of the pulley in inches; R, revolutions per minute, and W, the width of belt in inches. Substituting for the letters their values, we have:

$$H = \frac{18 \times 60 \times 1}{1{,}925} = 0.56,$$ which is equal to $33{,}000 \times 0.56 = 18{,}480$ foot-pounds of work transmitted. For single belts the formula is:

$$H = \frac{D \times R \times W}{2{,}750}.$$

These rules will not apply to all cases; circumstances and conditions will modify them. For belts, however, running under favorable conditions, the foregoing rules may be regarded as safe and reliable. It is here assumed that the belt is open, the pulleys over which the belt runs equal in diameter, or nearly so, and the arc of contact is nearly equal to the semi-circumference. 2. How much of this power will be lost in friction? *A.*—From 10 to 15 per cent., depending on the conditions of the bearings and belt, and the kind of lubricant used. 3. Is the size of this shaft sufficient for the power which the belt can transmit? If not, please state size of shaft and length of bearing. *A.*—The dimensions of the shaft you have given are correct, provided the pulley is put near the bearing, so as to guard as much as possible against the transverse stress. 4. A vertical two-strand conveyor is to be built, in which sprocket wheels and chains are employed. There are six buckets attached to the strands, each bucket carries a load of 46 pounds; raising a total load 276 pounds per revolution to a height of 20 inches; number of revolutions 60 per minute. What power is required to drive this conveyor, leaving friction out of consideration? Please give rule for finding the power. *A.*—In each revolution a weight of 276 pounds is raised to a height of 1.666 feet, and the work expended in doing so is equal to $276 \times 1.666 = 459.816$, say, 460 foot-pounds; and in 60 revolutions the work expended will be $460 \times 60 = 27{,}600$ foot-pounds per minute in lifting the load. Assuming that the load is at rest before it enters the buckets, there will be work expended in accelerating the load which should be added to the power previously found; but the exact amount that should be added will depend on the construction of the machine. 5. How much power will be required to overcome the friction? A. That also will depend on the construction of the machine. You will probably be not far out of the way by adding 15 to 20 per cent. of power required for lifting the load.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Lexington Cut Iron Gears. See adv. on p. 20.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Ice and Refrigerating Machines, 155 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Adjustable Shrinkage Gauges. Pedrick & Ayer Philapelphia, Pa.

Link Milling and Slotting Machine. Pedrick & Ayer, Philadelphia, Pa.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Standard Tool Co.'s Twist Drills. S. A. Smith, 23 S. Canal st., Chicago, Western Representative.

Well-drilling Machinery and Tools. Williams Brothers, Ithaca, N. Y.

Audubon Machine Works, New Haven, Conn. Special machinery, heavy and light.

Get particulars of our new Wall, Suspended and Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

One Star Hack Saw will do as much work as five of any other kind.—N. B.

F. C. & A. E. Rowland, New Haven, Conn. Hydraulic, Mill and Special Machinery to order.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For best Return Steam Traps, Pressure Regulators Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

Patent Attorney. R. G. DuBois, 715 11th st., Washington, D. C., procures first-class patents on inventions. Valuable Hand-book on patents free.

Horton's Chucks. We offer the balance of our stock at 50 per cent. discount. McFadden Co., Philadelphia, Pa.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See July 10, p. 18. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

25″ 28″ 32″ 36″ Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

25″ 32″ 37″ 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

C. H. Redman & Co., Newark, N. J., Manufacturers of Light Machinery, Automatic Selling Machines, Telephone and Telegraph Instruments, Sewing Machine Attachments, Models, etc. Contracts solicited.

For Sale—Bound volumes of the Patent Office Gazette for years 1883, 1884, 1885, 1886, 1887 and 1888. Price, $4 per year. Address J. C., care of AMERICAN MACHINIST.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections. Especially adapted for Valve Rod for Steam Engines. T. C. Dill Machine Co., Philadelphia, Pa.

Screw Propellers. Manufactured by H. B. Roelker, 22 Cortlandt st., New York. Superintendent of the late De Lamater Iron Works, of same patterns and designs as before, adapted to each vessel. Consulting Expert and Constructing Engineer. Estimates on machinery, damages, etc. Air ice machines.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

MANUFACTURES.

Ground has been broken for the car works by The Bessemer Land and Improvement Co.

A new needle factory is to be built at Torrington, Conn., and the old plant put up for sale.

Huntsville, Ala., claims to have just secured a gigantic cotton-mill, the capital stock of which is $1,000,000.

Baltimore parties are maturing plans for the erection of a $150,000 cotton-mill. W. L. Yost can give information.

It is now stated that arrangements have been completed for the erection of the basic steel plant at Buena Vista, Va.

J. H. Albragh and others are reported as organizing a stock company to erect a cotton compress at Rayville, Louisiana.

Large engine and boiler works will be removed from Evansville, Ind., to Sheffield, Ala. A cut nail plant is also projected at Sheffield.

The American Stock Food and Fiber Company, of St. Louis, Mo., is erecting machinery to experiment in the manufacture of paper from cotton-seed hulls.

H. R. Hamed has bought seventy-five acres of land at North Adams, Mass., and will erect a large two-story factory in which to carry on his washing machine business.

The stockholders of the Davol Mill, Fall River, Mass., voted last week to increase the capital from $300,000 to $400,000, the increase to be used for new boilers, engine and machinery.

The Beaufort (S. C.) Foundry and Machine Works will be started up within a few days. It is stated that the men have taken hold of it now who have the money to make a success of it.

R. G. Tomlin is president, and R. C. Harris, secretary, of the Cordele Machine Shop, for which a site has been secured, and work will be commenced at once. The capital stock is $25,000.

Several large cotton-mills are to be established in the States west of the Mississippi River, in order to capture some of the trade which is now possessed by the mills in the Gulf States.

The Americanite Manufacturing Co., of Washington, D. C., contemplates locating a factory at some point in Virginia, to manufacture its patent explosive, and is investigating Roanoke, Va.

Another extensive plant is about to be added to the Pittsburgh district. The Steubenville, Ohio, Iron and Steel Company has decided to move to McKeesport. It will employ 700 or 800 men.

A. J. McDonald Mfg. Co., Chicago, has been organized, to manufacture and sell railway safety gates; capital, $50,000; incorporators, A. S. McDonald, H. S. Dickson, and Isaac T. Dyer.

The Shenandoah Furnace Co., of Shenandoah, Va., will build a rolling mill to have a capacity of 600 tons per month and is having plans prepared. It also intends erecting another iron furnace.

It is reported that Israel Holmes and his son, Charles L. Holmes, are to establish a steel casting plant in Waterbury, Conn., the location being the Manhan meadows, west of West Main street.

George L. Morris is reported as to organize a company with T. T. Tillman and others to build an iron furnace in Birmingham, Ala., and develop iron ore on the Birmingham Mineral Railroad.

The Brosius Motor Sewing Machine Company, Atlanta, Ga., will, at an early date, enlarge its factory to at least double present size, and add new machinery, increasing capacity to 100 machines per day.

The Cambridge Iron and Steel Co., of Cambridge, Ohio, announces that its new mill for the manufacture of iron and steel sheets is now completed, and that it is ready to make prompt delivery on orders.

The Gibson Agricultural Works, of Chattanooga, Tenn., has been incorporated, with David Gibson president and A. L. Cayzer secretary. It will, it is stated, enlarge its plant and put in new machinery.

The paper mill of the Hubely Paper Company, at West Medway, Mass., which was burned recently, will be rebuilt at once. It will be 40x175 feet, with a stock-house 34x43, boiler-house 24x40, and bleachery 20x40.

The Lexington & Eastern Railway Co. contemplates constructing a railroad through Pike, Knott, Knox, Perry, Letcher and Leslie Counties, Ky. J. H. Crossman and Arthur Macy, of New York City, are interested.

A $250,000 car works is to be built at Americus, Georgia; a glass works at Atlanta; a knitting-mill at Bainbridge, and cotton-mills at Covington and Douglassville. Saw-mills are being built almost everywhere.

The new Stark Mill at Manchester, New Hampshire, will be started up in the fall, and then the help of the Stark corporation will be increased twenty-five per cent., so as to bring the total number of employes up to about 1,500.

The Massachusetts Construction Co. has been awarded, it is stated, the contract for constructing the Cape Fear & Cincinnati Railroad from Southport to Wilmington, N. C., 25 miles, and from Southport to Salisbury, 196 miles distant.

The Auburn Stove and Foundry Company has been organized at Auburn, Me., by the choice of H. W. Hutchins president, and J. R. Learned treasurer. Capital, $50,000. The plant of the Biddeford Stove Company will be removed to Auburn.

A railroad is to be built from Archangel to Vologda, to unite theextreme habitable north of the Russian empire with the interior. The contractors are merchants of Vologda, who carry on a large business with the natives of Archangel.

Forbes, Liddell & Co., of Montgomery, Alabama, manufacturers of cotton compressors, have been succeeded by the Liddell-Thompson Machinery Co., which will continue the business, and also do general engineering and contracting work.

It is stated that the Fall River Iron Works Company, Fall River, Mass., are contemplating an extensive addition to their cotton plant in the near future. It is probable that the foundation of another mill 500 feet long will be put in early this fall.

Park Bros. & Co., at their Black Diamond Steel Works, are adding six tubular boilers to their steam capacity in the plate-mill. The steam power in this mill had not been adequate for some time, and the new boilers have been erected to make up the deficiency.

The Illinois Central Railroad Co. (office, Chicago, Ill.), recently mentioned as to erect machine and boiler shops, and engine-house, will erect at Memphis, Tenn., a machine shop 32x114 feet, and a blacksmith shop 50x28 feet. The total cost will be about $22,000.

The Van Praag Railroad Association has been organized, with S. N. Van Praag chairman and John C. Witt secretary. The object of the association is to promote the building of the Mexican Gulf, Pacific & Puget Sound Railroad, from Pensacola to the Mississippi River.

A corporation, to be known as the Messinger Valve Company, has been organized at Kittery, Me., for the purpose of manufacturing and selling valves. The officers are: President, William T. Messinger, of Revere, Mass.; treasurer, George D. Wildes, of Ipswich, Mass.

The Trip Giant Leveler Company has been organized at Portland, Me., to manufacture machinery for shaping and leveling boots and shoes. The concern has a capital stock of $120,000, and its officers are: President, Charles A. Snow, of Boston, Mass.; treasurer, Edward P. Adams, of Cambridge, Mass.

The Morse Twist Drill and Machine Company, of New Bedford, will erect a brick building, 164x35 feet, two or three stories high, and an ell, 70x40 feet, one story high, on its premises. The main building will be thirty feet high, and the ell eighteen feet, and will be used as a machine and blacksmith shop.

The Tallahassee Northern Railroad Co. has been incorporated by C. H. Bennett and R. L. Bennett, of Philadelphia, Pa.; George W. Sason, B. A. Meginnis and Geo. Greenhow, of Tallahassee. The company contemplates constructing a railroad from Tallahassee, Fla., to some point in Georgia not yet decided upon.

Owing to a press in orders, the wire and galvanizing departments of the Braddock Wire Mill, at Braddock, Pennsylvania, did not shut down July 1, but will continue to run full time ten days longer. The new nail factory at this point will be an immense concern. Thirty machines have been put up and seventy more will be placed.

The Pittsburgh Iron and Steel Engineering Company has secured the contract for building the Bessemer plant of the West Superior Iron and Steel Company, at West Superior, Wis. The initial plant will contain two five-ton vessels, and will be completed early in 1891. The output of the works will be ship plate and merchant steel.

The Brown & Sharpe Mfg. Co. notify their patrons that the works at Providence will be closed from August 11th to 23d for annual vacation and repairs, and those having orders in contemplation will govern themselves accordingly. The office will, however, be kept open, and orders for goods in stock will be filled as usual.

The Manhattan, Newton & Gulf Railroad Co. has been incorporated at Topeka, Kansas, for the purpose of constructing a railroad from Manhattan, Kansas, to the Gulf of Mexico through Texas; capital stock, $4,500,000. A. R. Williams, Topeka; S. R. Peters, Newton, Kansas; S. M. Fox, of Manhattan, Kansas, and others are interested.

The Sherman & Northwestern Railway Co., of Texas, has filed its charter, with J. B. Harrison, O. T. Lyons, M. Snyder, George Murphy and others as incorporators; capital stock, $1,000,000. The company is organized to build a railroad to some point in Delaware Bend on the Red River. This is the road previously known as the Sherman, Ardmore & Denver Railroad.

What has been known as the Richardson Saw Factory, in Newark, N. J., has recently passed into the hands of Disston & Co., of Philadelphia, who have reorganized it, increased the capital stock to $250,000, and changed the name to the New Jersey Saw Manufacturing Co. A new building will be erected at once, and it is expected that 100 hands will be employed.

Michael F. Keeley, a Waterbury, Conn., iron dealer, has rented of Irving G. Platt, with the privilege of buying, the plant of the old Abbott & Root Brass Manufacturing Company on Maple street. Mr. Keeley will put in improved machinery for the washing of ashes from foundry furnaces to separate the particles of metal found therein. Smelting works will also be established.

The directors of the Excelsior Needle Company have voted to build a new factory on the west side of Field street, Torrington, Conn., on land adjoining the railroad. The building will be of brick, 300 feet long, 30 feet wide, three stories high, and as nearly fireproof as possible. Work begins at once and will be pushed as rapidly as possible. The present plant will be offered for sale.

Work on the Hopkins Rolling Mill at Slatington, Pennsylvania, is progressing rapidly. The foundations for the engines, boilers, furnaces, puddle trains and squeezers have been completed, and work on the superstructure has already been begun. Five boilers and a large amount of other machinery have been received, and it is probable that the mill will go in operation by October.

The Brunswick, Lake City & Tampa Railway Co. has made application for charter in Georgia, to construct a railroad about 40 miles in length from Brunswick to a point on the Florida State line to connect with the projected Florida division of same road; capital stock not less than $200,000 or more than $1,000,000. C. Downing, W. E. Burbage, J. M. Madden, M. Ullman and others are the incorporators.

It is reported that the Baldwin Locomotive Works, of Philadelphia, have purchased a large plot of ground next to their present shops and will increase the size of their plant, making it the largest in the world. Occupants of eighty tenement houses have already been notified to move out to make room for the improvements. Immense facilities will be added to the work before the close of the year.

The Thurmond Coal Co., of Thurmond, Fayette County, W. Va., is erecting one of the first electric mining plants in the State. The plant completed will cost about $20,000. The mines will be supplied with electric lights and electric mining machines. The dynamos will have a capacity of 350 amperes of current, which is equal to about ninety-four horse-power. They are so constructed that they are perfectly safe.

Much praise has been given to the English builders of cotton machinery for the excellent system of drawing which they have been building for the last few years, considerable of which is now in use in this country. The Atherton Machine Company, Lowell, Mass., seeing the need of an improved system of drawing in many of the mills, has perfected one that, wherever it has been tried, is pronounced to be fully equal, if not superior, to any in use. The company has made large sales of the same, having orders on hand now for several thousand deliveries. This company is to be congratulated on its great success in this line as well as in picking machinery.

The executive committee of the Sequachee Iron and Coal Mining Co. has started operations on the company's property in the Sequachee valley a few miles above Jasper, in Marion County, Tennessee. The company has approved the plan of the consulting engineer for the town site, has perfected a plan for a large hotel to cost $50,000, to be completed by October 1st, located coke ovens, 200 of which are to be constructed at once, laid out a park in a beautiful grove of natural trees in which is to be a lake supplied from the celebrated "Blowing Spring," and made arrangements for the construction of water-works which will be supplied from another famous spring which flows from the mouth of a large cavern on the mountain side. The company has about 30,000 acres of agricultural and mineral lands, containing both coal and iron, which it will develop.

A Texas man has got out a patent which is intended to solve the road question, especially in regions where good road building is very difficult and expensive. The patent is called the "Railroad for Wagons," and the method of operating is described as follows: "Through an exceedingly bad road, say bottoms and marshes, a grade, say 20 feet, is first made. On this grade are placed crosswise every four feet wooden ties six feet long. On these ties are laid and fastened, four feet ten inches apart, two flat iron rails four inches wide, of sufficient thickness to hold up the heaviest loaded wagon. These rails have a flange on the inside two inches high, to keep the wheels on the track. The space between the rails is planked, sanded or graveled, as the necessity of the case may require. The approach to the track is guarded by inside flanges that curve inward to guide the wheels to the track." Thus equipped this kind of road is claimed to afford easy and sure travel in any season of the year, and in any kind of weather, besides furnishing a road of several years' duration, the grade being the only thing liable to get out of repair. This road, complete in all its parts, can be built, it is estimated, for $1 per running foot, and in some places for less, making it cheap, as well as safe. Switches are to be put in for passing wagons.

The proposed extension of the Rio Grande Western Railroad from near Springville, Utah, to the Tintic mines is to be built to utilize the narrow gauge equipment and material released from the main line on account of the widening of the gauge to standard. There are two routes under consideration—one from the main line at Lehi around the north point of Utah Lake; thence along the west shore of the lake, crossing the south end of Cedar Valley, and thence via Bolter Pass to Eureka, a distance of about 54.5 miles. The second route is nearly the same, except at the start. It leaves the main line at Springville, and extends around the south end of the lake, and is considerably longer than the first, but has the advantage of running through several thriving towns south of Springville. There are two locating parties now in the field engaged on preliminary locations. No heavy work is encountered until within three miles of Eureka, and this can be avoided by sharp curvature. With this exception the maximum curve is 8 degrees. The maximum grade for trains going west is 1.5 per cent., and for trains going east it is 1.0 per cent. It is expected that contracts will be let and work begun as soon as the relative advantages of the two routes are fully determined. E. J. Yard is resident engineer. In referring last week to the completion of the standard gauging of the main line between Ogden and Grand Junction, the cost of changing the line to standard gauge and in purchasing the new equipment therefor was given as $1,500,000, but the outlay for these purposes has already been over $4,000,000; the expense of completing some additional work which yet remains to be done, and of a large amount of new rolling stock, which will soon be ordered, will make the total cost of the work about $5,000,000. The first standard gauge train was run June 10. The greatest care has been taken in the reconstruction of the line, to make a solid road-bed, and to reduce grades and curves. The maximum curvature has been reduced from 20 degrees to 8 degrees; the total reduction in curvature in the whole line being about 8,000 degrees. The road will be rock-ballasted. On many sections the old line has been abandoned and shorter sections built. The actual distance saved between Salt Lake City and Grand Junction by the shortening of the line is 18 miles. The grades in no instance on the new line are over one per cent., except for a distance of about six miles in going east over the mountain between Thistle and Helper, and 12 miles through Price Canon going west An extra engine will help draw the trains over this grade, and this is the only place on the entire road where this will be necessary. One engine is hauling trains of seven heavily loaded cars from Green River over the mountain to Provo. The longest stretch of new track is between White House and Crevasse, where 56 miles of the old line was reduced to 44 miles, taking the line down to the Grand River at West Water. The present new equipment consists of eight first-class and eight second-class cars, eight mail and express and eight baggage and two combination cars. These cars were built by the St. Charles Car Co., and are all strongly built, the passenger cars being very handsomely finished. Twelve new Pullman parlor cars will be used. There are 25 freight consolidation engines, with 20x24 in. cylinders and four pairs of 46-in. drivers, built by the Baldwin Locomotive Works; also ten passenger engines from the New York Locomotive Works at Rome, N. Y., six being for mountain work with 18x24 in. cylinders, and four for running across the desert with 17x24 in. cylinders, the entire lot having 54-in. wheels. In the reconstruction 34,000 tons of 65-lb. steel rails were bought from the Illinois Steel Co., and 700,000 new ties were used. The road has leased 18 miles of road from the Denver & Rio Grande, from the State line to Grand Junction, for 50 years, and has secured joint yard and terminal facilities with that line. The extension from Thistle to San Pete and Sevier Valley will be 175 miles. The grading is now completed to the asphaltum beds, and tracklaying begins soon. H. T. Reynolds, of Springfield, Utah, has the contract.—*Railroad Gazette.*

Heating and Lighting Passenger Trains.

The Chicago, Milwaukee & St. Paul Company has had in operation for some time, on one of its passenger trains, a special arrangement for supplying steam heating and electric light to the train. This is done by a "light and heat tender," which is a special car designed by Mr. George W. Gibbs, mechanical engineer of the road. This car, which is carried next to the tender, and is mounted on passenger car trucks, has an unusually strong floor framing to protect it against accident, and is covered outside with steel plate ¼ in. thick, the end doors being also of steel. It is 34 feet long by 9 feet wide over all, and is divided into two parts by a partition, which is also covered with steel plate and provided with a steel door. The larger division is 20 feet in length, and contains a boiler of the locomotive pattern, which supplies steam for heating the train and also for running the engine in the other compartment. Back of the boiler are placed the coal boxes, one on each side, leaving room between them for the fireman. The water supply is drawn from the locomotive tender. In the smaller division of the car is a Westinghouse engine of 15 H. P., which runs an Edison dynamo. This dynamo is connected with a switchboard from which wires are carried to the cars for the electric lights. The engine and dynamo are placed on one side of the car, and their weight is balanced by a tank placed on the other side, in which is carried a supply of water for the boiler, which can be drawn upon when the engine is detached, or in case any accident should happen to the couplings connecting with the locomotive tender.

When the car was first placed in use a set of storage batteries was carried, in case the engine or dynamo should break down, but this has been found unnecessary, and the batteries are no longer carried.

The system has been found to work very well. In the summer time, when it is not necessary to heat the train, the special car is laid aside and the dynamo and engine placed in the baggage car, steam being supplied to the engine from the locomotive boiler.—*Engineering Journal.*

Practical Details of Blacksmithing.

BY B. F. SPALDING.

WELDING—MEANS OF HEATING—COLD WELDING—UNITING DIFFERENT METALS—THE PUDDLING PROCESS—EFFECTS OF ROLLING—REPORT OF U. S. COMMISSION—WELDING STEEL—RANGE OF TEMPERATURE.

Welding is the uniting together of more or less separated masses of a metal which have been brought to a viscous, semi-fluid condition by heat. The operation is perfect when the internal structure of the piece is the same at the place where the parts have been joined as it is elsewhere, and approximates to perfection, in proportion to the extent of the region in which the particles of the original parts mingle and interlock with each other.

Heat for welding may be generated at one operation by the combustion of fuel in a solid, liquid or gaseous state, or by electricity. The line of probable improvement is in the perfecting of furnaces for coal or oil by the improved application of the blast, and discharge of the products of combustion with the retention of the heat—in the use of gas, or a combination of gases; and in the more extended use of electricity.

The use of electricity for the purpose of welding deserves consideration, for one of the principal advantages claimed for it is that it can be applied by persons unskilled in the trade, therefore, as its application becomes more extended, less skill will be required of the workman, and not less skill only, but less hardihood, and capability of bearing heat, for the reason that in electric welding all the heat generated is concentrated at the point where it is to be used, instead of nine tenths of it being diffused, with the result of raising the temperature of the surrounding atmosphere, in which the workman must stand, to 30° or 40° above blood heat. According to the latest labor theories, this will have the effect to increase the wages of the operator, for although he may require less skill, he must exercise greater intelligence, and as employments recede from the barbarism of excessive manual exertion, and require greater intelligence, they are more liberally recompensed.

Among the illustrations which accompanied the description of the Bernando's system of electric welding, which met with such favor four or five years ago, was one of welding a patch into the shell of a boiler, by this process—a feat which one of the savants who had its promotion in hand was said to have successfully accomplished—and no one who gazed upon the picture of the cool, calculating scientist, deliberately directing the forces of nature to the purpose of his undertaking, could fail to mark the decided superiority in the appearance of that method of doing the work, over the hot, blood-boiling, flesh-roasting, and ear-spliting, old-fashioned method.

Every advance in the arts lessens toil and hardship. The puddler's rabble is superseded by aeration. Immaterial forces overcome the grosser. Wm. Denning, the Penn.

Cumberland Co. blacksmith, who forged wrought-iron cannon during the revolutionary war, by welding hoops over staves, which were so laid as to break joints, complained that he could get no one to help him, as "the heat was so great as to melt the buttons off from his clothes"—but in later years these big heats are held off at the end of a long porter bar, swung to a crane, and moved up to receive the blows from a steam hammer, while the forger can wear lead buttons, or a celluloid collar, if he chooses, without fear of the consequences.

By the use of the electric process of welding, the blacksmith will be relieved of much of the heat, uncleanliness, dust and other discomforts which have generally been the accompaniments of welding operations, and if the heat can be controlled, and regulated with the accuracy which is claimed for it, a piece can be kept at a welding heat—at a temperature between 2,400° and 2,800°, for an indefinite period, without loss by oxidation or otherwise, becoming thoroughly softened throughout the portion which is to be welded, and the operation of uniting the separate pieces can be carried on without haste, but with whatever deliberation may be necessary to insure a perfect union.

The term "welding" has come to be rather loosely applied. Probably platinum possesses what may properly be called the welding quality in a high degree. Advantage is taken of this in the manufactures of that metal, but it is so rare, and the processes by which it is wrought are so unfamiliar, that, by general usage, the term "welding" is principally confined to the uniting of similar or slightly varied forms of wrought-iron, as wrought-iron to wrought-iron, or to steel, and steel to steel.

When two cold surfaces of metal are worked, one upon another, in such a manner as to exclude everything from between them, and bring their particles into immediate contact, they "catter-claw" and unite very firmly at whatever points are brought thus near. When pressure is applied to separate them, as when force is used to turn a shaft which has stuck in its boxes, or a wheel on an axle, or to move a slide stuck in its guide ways, the surfaces "rough up," form "cat teeth," and are then said to have been "cold welded." There is undoubtedly a knitting of fiber, and although the portion of fiber so knit is very short, its grip is as tenacious as many hot welds on thin pieces.

A question may be opened whether the uniting of two different kinds of metal may properly be called welding. A chronometer balance wheel has a steel center and inner ring, and firmly united to this inner ring is an outer ring of brass, which in some places is put on in this way: Pieces of steel about three inches long are carefully centered, and turned to the size of the outside of the steel ring; they are then coated with borax in aqueous solution, and driven into hollow cylinders of brass, which are then put into clay crucibles, which they just fit, and the open end is closed with clay. They are then subjected to a heat high enough to melt the brass, and set aside to cool. When cool, the centers are carefully cleaned, and the brass, being turned on the same centers, is concentric with the steel. They are cut up into the required lengths for the balance wheels, and the brass is found to be thoroughly united to the steel. These two metals are united for the sole purpose of getting the result of their unequal expansion. Changes occur at every variation of temperature; they are irregular, but continual, yet do not affect the union of the metals, because they are free to move. The steel points of mathematical instruments are united with the brass or German silver heads in a very perfect manner, but I do not know that, until quite recently, it has ever been claimed, by parties engaged in that kind of work, that this uniting of two different kinds of metal constituted a weld.

It would be exceedingly difficult to find any two metals which have not been intimately united together for some useful purpose, with a firm jointure, while their surfaces were in a fluid or pasty condition from the action of heat. It is an art which has so long been practiced, that it may probably date from the first discovery of the metals.

The best conditions for the thorough welding of iron are probably present in the manufacture of the muck bar, which is the direct product of the puddling process. When iron has been subjected to this process, it "comes to nature" by appearing in the fluid mass, which is melted down on the hearth, in the form of grains, which assemble together, and are brought into a rough ball by the puddler's rabble. These grains are separated from each other, more or less, by the melted silica, which envelopes each one, and which forms a large part of the melted slag in which they are immersed. This puddler's ball is squeezed by some form of squeezer, which presses these grains together, so that they intermingle with each other, and the slag is forced out from between them. They are then run through the puddle rolls, and these carry on the process thus begun, of uniting the grains, and squeezing out the fluid slag. It is curious that, in passing from the puddle ball to the puddle bar, the percentage of carbon thrown off should exceed that of silicon, being in one case a loss of 61.6 per cent. of the carbon, against 28.5 per cent. of the silicon.

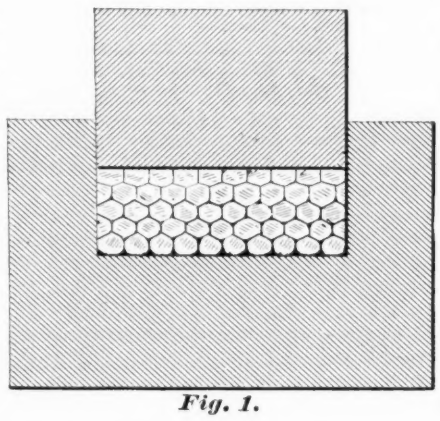


Fig. 1.

When the iron appears in the form of the puddle or muck bar, the surface grains, having been acted upon directly by the unyielding surfaces of the rolls, have become flatted more on the outside than on the inner side, where this action was resisted only by the slag-supported grains. Those lying furthest from the surface are less flatted than those lying near it, in proportion as their distance from the surface increases. An illustration of this may be obtained by placing some bird shot in a box, just wide enough to receive it, and of such length and depth as may be suitable, and pressing it therein with a movable close-fitting die, as shown in Fig. 1. The grain at the surface of the bar would be flatted like the shot, immediately under the die, while that in the interior would be more globular in form.

The puddled bars are very rough and imperfect, and to make the iron fit for use they are cut to lengths, and these are piled upon each other; and for merchant iron the pile is reheated to a welding heat, and reduced by rolling or hammering to the form and size required.

The tendency of matter in a fluid condition is to form globules. When two pieces of merchant iron are heated, and their surfaces brought together, the work done on them, having made the top of their granules flat, the joint produced is continuous, like that between two planed boards, which will not glue as well as if they are somewhat roughened, but if the heat is raised so that the fluid tendency to form globules will be exhibited, those on one bar will fall in between those of the other, producing a more thorough interlocking. If the liquidity extended through the bar, it would not cohere strongly enough to hold itself together, but it may be brought nearly to this state on the outside, and there not being so rapid a conduction of heat as to cause it to become so at once inside, there will be below the exterior, when it is finally brought to a fluid state, a semi-solid condition, in which the globular form is exhibited, and as this is more or less developed, so will the weld approach to a homogeneous combination of the two individual masses, the melted portion of each uniting, and adapting the form of its particles to the shape of the firmer base on which they rest.

With the exception of the flattened form of the exterior particles, the conditions for securing good welding are present when the pile of puddled iron is worked over into merchant iron; and it would appear that if thorough incorporation of separate and distinct masses of iron into one mass can be produced by welding, the merchant bar would be a fair sample of such an incorporation; but one of the first things which an apprentice discovers is that such iron is more liable to split when punched in the seam than when punched the other way of the bar. This seam is the weld between two of the pieces which were piled together, and the fact that the bar is more liable to open in these seams than it is when punched through them, shows that the bars of the pile are not united as strongly as the grains are united which compose the bars.

The committee on chain cables of the United States board appointed to test iron, steel, etc., reported that the blows struck in making the lap amalgamated the fibers together so that "when the two laps are brought into contact the fibers of each do not intermingle thoroughly, and they, too, are frequently simply stuck together, adhesion taking the place of a process similar to felting, which occurs in welding iron of rather an open fiber." "Welding power was traced to the reduction of the bar by direct experiment." "Omitting one course of piling and hammering largely helped its welding power." "Carbon notably affected welding." It "promotes fluidity, hence the iron is 'burned' at the ordinary welding temperatures of low carbon irons." "Slag should theoretically improve welding like any other flux, but its effect in these experiments could not be definitely traced." Slag was highest in a bar which welded less soundly than any other bar of the same iron and below average as compared with other bars. The conclusion they reached after many experiments is given in these words: "The ordinary practice of welding is capable of radical improvement. The perfection of means for welding in a non-oxidizing atmosphere would seem to be the most promising direction of improvement."

As steel is of less open grain than iron, this is one reason why it is not so easily and thoroughly welded. There are other reasons, and as throwing some light on the welding of steel, the behavior of copper may be noted. If it be attempted to weld copper as iron is welded great difficulties are encountered. Two bolts of copper may be put in the fire of a blacksmith's forge, and the heat raised on them until the ends are hot enough to melt and flow; but as fast as any portion arrives at this heat it becomes so fluid that it drops off, and if the bolts are pulled out and laid on the anvil to unite them, it will be found that there is no longer a liquid surface on them to make them stick together. The conductivity of the metal is so great that the heat needed to flux it is almost instantly conveyed away.

The distinction must be made that the melting of metals together and the welding of them together are two different things, and yet it is not an easy matter to determine the limits of the processes and define their confines. Perhaps the best way to illustrate it may be with irons of different degrees of carbonization. Cast-iron pieces may be melted together, as is often done in mending castings. The steel faces of cast-iron anvils have been put on by a modification of this process. The harder steels containing 1.35 to two per cent. carbon will not weld; when they are hot enough to unite they will not bear to be struck. As the amount of carbon falls below 1.35 per cent. the thickness of melted metal coherent enough to remain attached to the heated piece increases from the mere film which just barely coats steel to the spongy mass into which wrought-iron may be brought, so deep that shafts 20″ or more in diameter are forged at a temperature as hot as a welding heat throughout, the whole mass being in a soft, nearly molten condition.

In non-weldable metals there is a distinct narrow line of demarkation between the melted and the unmelted condition. In weldable metals the line is considerably broader. There is a condition between these two states, and in the most weldable this middle condition is the most considerable. Silver may retain its integrity at 1,830°, and have no appearance of fluidity, but at 1,832° it is melted; but wrought-iron has a fluid surface at 2,400° and does not melt and disintegrate at less than 2,800°, thus having a range of 400° in which the process of uniting separate pieces may be effected. Steel may have a film of liquid surface at a little above 2,300°, and melts at 2,450°, or less, according to the proportion of carbon it contains. Cast-iron melts at 2,200°, and becomes fluid without passing through any intermediate range of temperature.

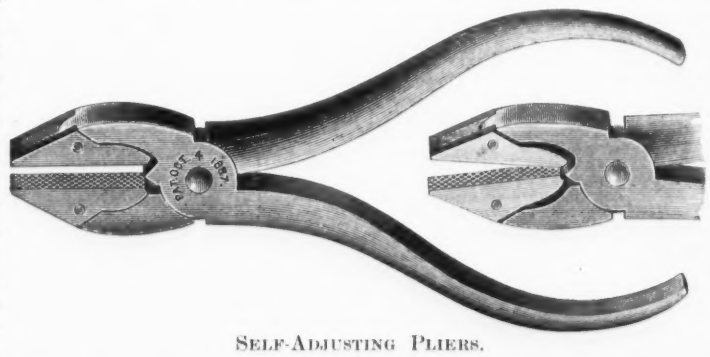
Wrought-iron softens by heat step by step by more gradual degrees than any other metal in common use. In copper it is a short and sudden step from the solid bar to the liquid mass, but in iron there are regular gradations of growing viscosity from hardness to fluidity which are so distinctly marked as to be perceptible. The presence of any of the substances which promote fluidity lessens the range of the welding temperature. The thermal conductivity of the material has a great effect upon limiting the range of the welding temperature.

Where Newspapers are Appreciated.

The *Western Journalist* asserts that the press tickets issued by the Henry County Fair Association bear the following legend: "This ticket, probably, has been paid for ten times over by the paper to which it is issued. It will be honored in the hands of any man, woman or child, white, black, red or yellow, who favors the association by presenting it. It is good for entrance and grand stand, and the bearer, if driving, will be entitled to pass a team free. The association recognizes the fact that its splendid success is owing largely, if not wholly, to the notices so freely given by the press, and while we cannot render an equivalent in cash, we return our grateful thanks."

Self-adjusting Pliers.

One of the difficulties experienced in the use of pliers of the ordinary kind is that the jaws very seldom get a fair bearing upon what may be put between them, as they are not parallel except when closed, and there is no means of making them conform to the shape of the piece held. Our illustration represents a plier in which this difficulty seems to have been overcome. Its construction will readily be understood from the cut,



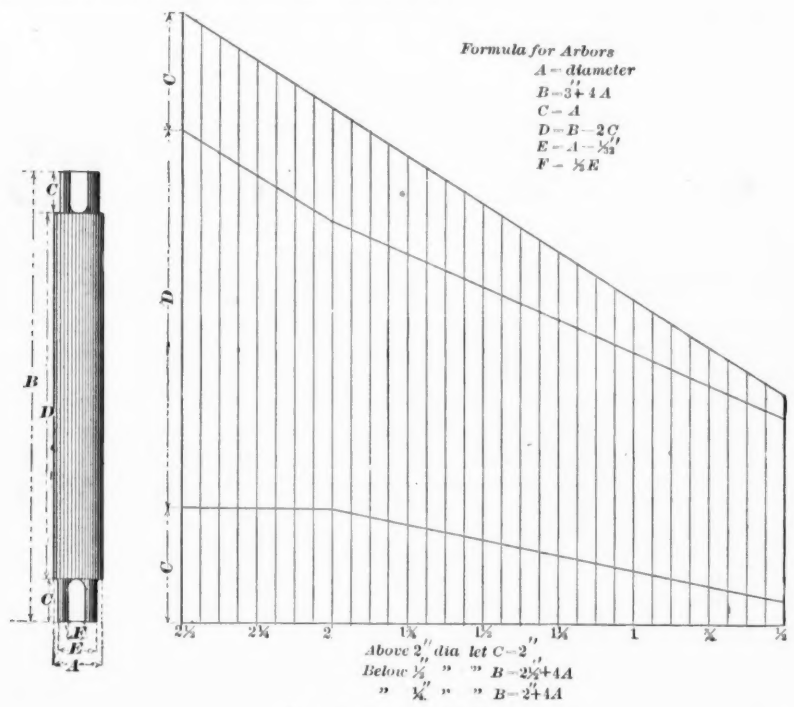
SELF-ADJUSTING PLIERS.

which shows that there are two movable pieces on the jaws, which are pivoted in such a manner that they adjust themselves to the form of the piece held, and always come to a full bearing. They are so made as to be strong, and the jaws, being interchangeable, can be replaced at a slight cost. They are made of drop-forged steel in the best manner by George A. Church, Meriden, Conn.

The man whose antecedents make
The little he can brag on,
In things pertaining to success
Is apt to be as valueless
As that admitted uselessness—
The fifth wheel to a wagon.

We are no poet, nor even a writer of verses, but nevertheless we are able to say that there is something wrong with the above, which we find floating about in the newspapers. The sentiment is all right, but instead of ending with the word wagon, it should be cart. This would knock both the rhyme and rhythm all to flinders, it is true, but the fact is that a fifth wheel is a very necessary thing to a wagon, and it would be very difficult to get around a corner with one that had no fifth wheel; and we insist that poets who propose to write about wagons shall show some knowledge of, and respect for, wagon anatomy.

Last week we published a communication from Wendell Willis, in which he spoke of the desirability of having formulas and diagrams by which uniformity in shop tools might be secured. By an oversight, the cut intended to accompany his article was omitted, and remembering the saying, "Better late than never," we publish it on this page.



FORMULA FOR ARBORS.

Machinists' Supplies and Iron.

NEW YORK, July 12, 1890.

Iron—American Pig—Dullness characterizes the market, and concessions have been obtained by buyers from both Southern and Northern furnaces, though the best grades of Northern are firmly held. A dull market is looked for at this season, and there is therefore very little uneasiness felt among holders, and it is confidently predicted that demand will increase within a month.

We quote Northern No. 1 Foundry, $18 to $18.50; No. 2, $16 to $17. Southern No. 1, $17 to $17.50; No. 1, Soft, $16.50 to $16.75; and No. 2, $16 to $16.25.

Scotch Pig—The demand has been moderate. We quote Eglinton, $18 to $18.75; Dalmellington, $20.50 to $21; Coltness, $23.50 to $24.

Bar—The demand has been fairly good, and the market firm.

We quote Common, $1.85; Medium, $1.90; Refined, $1.95 to $2 for round lots on dock.

Copper—The market has ruled quiet and firm. The Lake mining companies have fixed their prices at 17c., but some supplies are still to be had from outside sources at 16½c. to 16¾c. Casting brands are held at 14½c., Arizona, 15½c.

Lead—The market has ruled dull, but firm. No sales of importance having been made.

We quote for near delivery 4.55c. to 4.57c.

Spelter—The demand has been moderate, but sellers have been firm.

We quote ordinary brands of Western, 5.45c. to 5.60c. Choice, 5.70c. to 5.75c. Refined, 6.75c. to 7c. Silesian, 7⅛c. to 7¼c.

Tin—Values have undergone no change here, though there has been some rise in London. Values range from 20.75c. to 21c.

Antimony—The demand for Regulus has been moderate, and the market has been steady.

We quote Hallett's, 21c. to 21¼c., Cookson's, 25c. to 26c.

Lard Oil—The market has ruled quiet, with prices at 49c. to 50c. for Prime.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Lathe and vise men; steady work, good wages. The Charter Gas Engine Co., Sterling, Ills.

Wanted—1st-class vise and machine hands. Ott. Mergenthaler, Clagett & Allen sts., Balto., Md.

Wanted—Good die sinker. P. O. Box 316, Buffalo, N. Y.

Wanted—Competent mechanical draftsman, good education, familiar with steam and hydraulic machinery. Engineer, AMERICAN MACHINIST.

Wanted—A good machinist on light, accurate work. Also, a master mechanic for woolen mills. H. B. Morris, Geneva, N. Y.

Wanted—Some moulders and machinists on engine work, about 40 miles from New York City. Address Box 35, AMERICAN MACHINIST.

Wanted—Machinists; steady work and good pay for first-class men. Apply at once, Ticonderoga Machine Co., Ticonderoga, N. Y.

Wanted—A strictly first-class machine blacksmith to go South. Must be sober. Address, with references, A. B., P. O. Box 799, N. Y. City.

A young married man, at present foreman of a large machine shop in a middle State, wishes to change. Address Box 42, AMERICAN MACHINIST.

Wanted—Mechanical engineer. Must be first-class draftsman. Good chance for right party. State age, experience and salary. Address R. Schenck, 26 W. Lake st., Chicago.

Wanted—Position to take charge of shop making small tools for interchangeable work, also experimental work; long experience and best references. Box 43, AMERICAN MACHINIST.

Machinists Wanted—First-class floor hands and fitters of large experience and of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, O.

Wanted—Machinist who has had experience building automatic high-speed engines, to take charge of department. State experience and salary. A. Robb & Sons, Amherst, N. S., Canada.

Wanted—A 1st class blacksmith on general light work. Address, stating age, experience, past and present employers, The Taunton Locomotive Manufacturing Co., Taunton, Mass.

Wanted—First-class machinists. Good pay and steady work for the right men. Large profits on contract work. Apply at once. Betts Machine Co., Wilmington, Del.

Machinists Wanted—Fifty first-class bench and machine hands wanted. Only those acquainted with high-class machinery need apply. Steady work and liberal wages. Address, Dominion Typograph Co. (Limited), Windsor, Ontario.

Wanted—A thoroughly practical mechanical draftsman; one who has worked as machinist in the shops preferred; also a knowledge of cylinder printing presses would be a recommendation. Address P. O. Box No. 2101, N. Y. City.

Wanted—A partner with $2,000 to $4,000 in a good established machine business in the best city in Tennessee, a first-class foundryman, pattern maker or machinist preferred. Address Machinist, Box 123, Knoxville, Tenn.

Wanted—A first-class draftsman with experience in designing machine tools and special machinery. State age, experience and pay. Wanted—A thoroughly competent iron-cock maker. State age and experience. Address, Box 41, AM. MACHINIST.

Wanted—To add to office force in large shops in Chicago, one or two draftsmen experienced in Corliss and general engine designing, also one or two draftsmen experienced in mill building, constructions and general machinery. Address Box 40, AMERICAN MACHINIST.

Wanted—Foreman for our pattern shop, a pattern maker who is master of his trade, who has a good education and a thorough understanding of drawings, and who has had experience in architectural iron work. A permanent position and a good salary to a competent man. Address The Snead & Co. Iron Works, Louisville, Ky.

Wanted—Mechanical engineer for a large machine works. Must be able to design, estimate and construct rolling mills and furnaces, engines, mining and hydraulic machinery, heavy gearing and general heavy machinery. The right man will find this a good opportunity for advancement. State age, experience, and salary expected, and send copies of references. Address Box 37, AM. MACHINIST.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 15 cents per line, each insertion.

Cheap 2d-h'd Lathes & Drills. S. M. York, Clev'd, O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, Ohio.

BRADLEY HAMMERS AND FORGES.

The BEST HAMMERS in the WORLD RUN BY BELT.

Over 1500 In Use.

Three Styles, 15 lb. to 500 lb. Heads.

Our FORGES heat irons fast enough to keep Hammers and men fully employed.

Send for Catalogue and Prices.

BRADLEY & COMPANY, Syracuse, N. Y.
14 Warren St., NEW YORK. 18 Sudbury St., BOSTON.

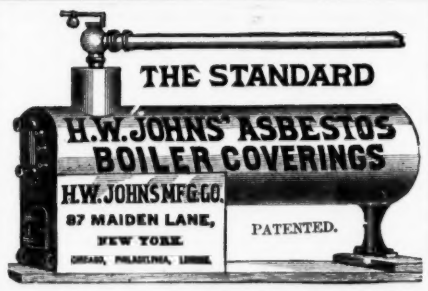
INJECTORS, PUMPS, AIR-BRAKES, VACUUM BRAKES, and other Locomotive attachments are clearly described by the aid of GOOD, SIMPLE ILLUSTRATIONS.

SINCLAIR'S
Locomotive Engine Running & Management.
15th Edition. Price, $2.00.
JOHN WILEY & SONS, 53 E. Tenth St., N. Y.

THE FOX PATENT UNIVERSAL TRIMMER
OVER 2200 IN USE.

ORIGINAL Saves Time, Three Sizes, IMPROVED Saves Money. From New Pattern.

NO PATTERN ROOM COMPLETE WITHOUT THEM
Send for circular. Mention this paper.
THE FOX MACHINE CO., GRAND RAPIDS, MICH.

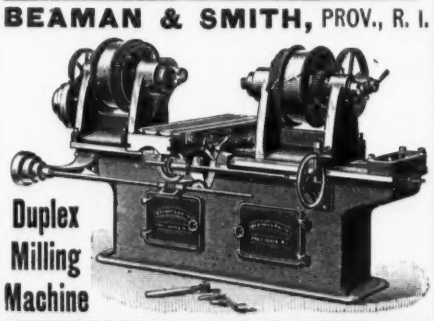


ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.

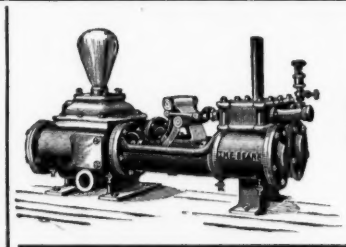
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.

BEAMAN & SMITH, PROV., R. I.

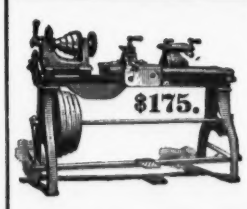


Duplex Milling Machine



THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

BEST STEEL
For Taps, Dies, Punches, Milling Cutters, Lathe and Planer Tools, Cold Chisels, Edged Tools and Hardware of all kinds.
CRESCENT STEEL CO.,
136 FIRST AVE., PITTSBURGH, PA.
64 & 66 So. CLINTON ST., CHICAGO, ILLS.
490 PEARL STREET, NEW YORK, N. Y.



Improved Screw Cutting Foot and Power LATHES
Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
THE SEBASTIAN-MAY CO., 167 W. 2d St.,
CINCINNATI, O.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

TOBIN BRONZE
Tensile Strength upwards of 79,000 lbs. per sq. in.
Torsional Strength equal to the best Machinery Steel.
Anti-Frictional and Non-Corrosive.
CAN BE FORCED HOT.
Rods for pumps and bolts. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, &c. Ingot metal for car and engine bearings. Spring wire.
ANSONIA BRASS & COPPER CO.,
Sole Manufacturers.
Send for Circular. CHICAGO. NEW YORK.

GEO. F. BLAKE MANF'G CO.
BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.
WATER WORKS PUMPING ENGINES A SPECIALTY

BETTS MACHINE COMPANY,
WILMINGTON, DEL.,
MAKERS OF
METAL-WORKING MACHINE TOOLS
FOR
Locomotive, Bridge and Engine Builders, Railroad, Car and Machine Shops
AND
Iron and Steel Works Generally.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Wanted—Customers for our new Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Wanted—Two second-hand engines in good repair; one about 5 and the other 10 horse-power. S. R. & J. C. Mott, Bouckville, N. Y.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Wanted—A 2nd hand automatic engine, about 50 H. P., Corliss type preferred. Address, stating price, condition, etc., W. H. Allen, Box 51, Buffalo, N. Y.

Wanted—To buy second-hand lathes, planers and shapers of all sizes. Must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

Wanted—Engineers to write for Catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Electric Motors for driving fans, lathes, sewing machines and other machinery, ⅛ H. P., and larger for incandescent circuits. Large medical batteries for street attractions and other purposes. L. G. Hall & Co., Electricians, 170 Merrimack st., Lowell, Mass.

Parties with offices in New York City, who make all their own designs and own their patterns, are now selling a line of machinery, and desire to contract with some shop with modern facilities, to build these machines and carry same in stock until sold. 6 per cent. interest will be paid the manufacturer on cost of machines while same is carried in stock. The machines have a ready sale, and no risk will be run, and having machines for immediate delivery will greatly increase sales. $4,000 to $5,000 will carry the stock at present. Stock machines weigh 1,000 to 3,000 lbs. each. Machines, built to order only, will be made that will weigh 6 to 8 tons each. Address B. & Co., AM. MACHINIST.

NICHOLSON FILE COMPANY,

PROVIDENCE, R. I.

FILES AND RASPS

FOR EVERY VARIETY OF WORK.

HENRY CAREY BAIRD & CO.,

INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,

810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

8,200 Copies of "PRAY'S BOOK,"

20 YEARS WITH INDICATOR

Sold to March 30th, 1890. Vols. 1 and 2 in one vol., $2.50.

JOHN WILEY & SONS, 53 E. 10th St., N. Y.

MACHINE TOOLS FOR SALE.

One 8-ft. pulley lathe, $500; one 18-in. New Haven lathe; one 36-in. drill press. Lot vises, anvils, general outfit of machine shop; cheap; no further use for them. Logan Machine Works, Oil City, Pa.

REDUCED PRICES OF LECOUNT'S STRAIGHT TAIL DOG.

To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE.
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1.45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk, Conn.

ENGINEERING DEPARTMENT
VANDERBILT UNIVERSITY.

Courses in Civil, Mechanical and Mining Engineering, and Manual Technology. 12 Professors, 10 Assistants; two buildings, extensive facilities, field outfits, draughting-rooms, laboratories and shops. Tuition, $65 per annum. Free course in highway construction. For catalogue of this or Academic, Law, Medical, Biblical, Dental or Pharmaceutical Departments, address at once

WILS WILLIAMS, Bursar, NASHVILLE, TENN.

THE PECK PATENT DROP PRESS

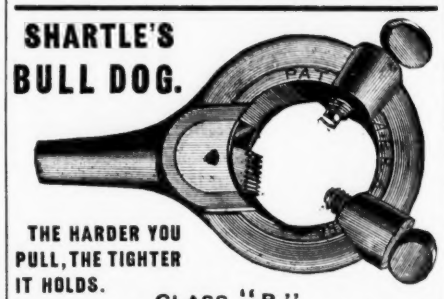
MINER & PECK MF'G CO.

SUCCESSORS TO BEECHER & PECK

NEW HAVEN, CONN.

DROP FORGINGS

SHARTLE'S BULL DOG.



THE HARDER YOU PULL, THE TIGHTER IT HOLDS.

CLASS "B."

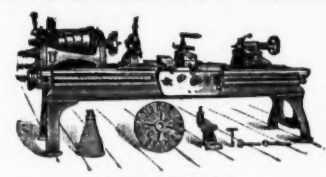
This style is made for general machine shop use from 1 3-4 in. to 8 in. or larger. Can't slip. No wrench required, and satisfaction guaranteed. Write for catalogue showing the different styles. MANUFACTURED BY

The Middletown Machine Co., Middletown, O

Fitchburg Machine Works.

Manufacturers of

METAL-WORKING MACHINES.



OFFICE AND WORKS,

13 to 21 MAIN STREET,

Fitchburg, Mass.

Send for Catalogue (E.)

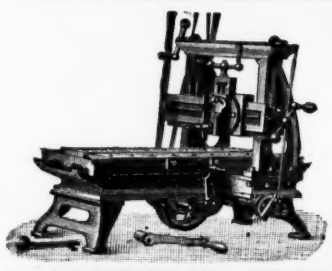
JESSOP'S STEEL

For TOOLS, DRILLS, DIES, &C.

All Kinds in Stock.

Gold Medal, Paris, 1889.

MANUFACTORY, WILLIAM JESSOP & SONS, L'D. | SHEFFIELD, ENGLAND. | Chief American Office, 91 JOHN ST., NEW YORK.



SMALL POWER OR HAND PLANER.

FOR ANY SMALL WORK.

Weight of Platen 100 lbs.

A. J. WILKINSON & CO.,

184 Washington St., BOSTON, MASS.

SEND FOR CIRCULAR.

WM. BERKEFELD'S FOSSIL MEAL COMPOSITION.

The Only Genuine Fossil Meal.

The best non-conducting material known for Steam Pipes and Boilers. Can be easily removed and repeatedly reapplied.

ITS PLASTIC NATURE INSURES AN ABSOLUTELY TIGHT JOINT.

Requires less thickness than any other covering, and is therefore the CHEAPEST.

Trade-mark. W. B. C.

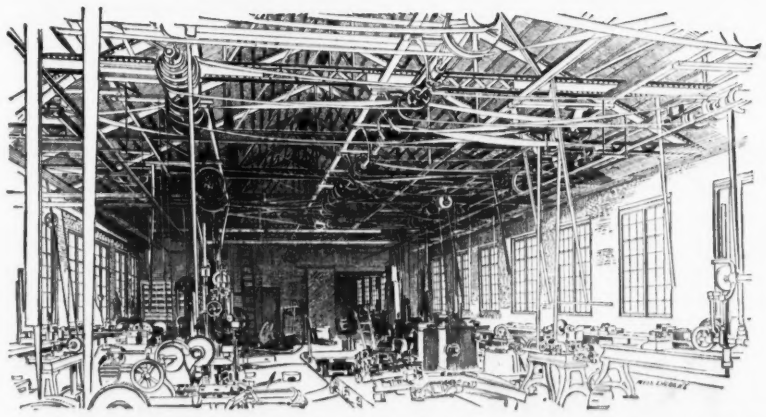
FOSSIL MEAL CO., 2 Cedar Street, N. Y.

A. GIESE, Proprietor.

BUFFALO FORGES.

BUFFALO FORGE CO., BUFFALO, N. Y.

THE BERLIN IRON BRIDGE CO.



This illustration is taken direct from a photograph of an iron roof built by us for The C. W. Hunt Co., at West New Brighton, Staten Island, for a Machine Shop. The building is 42 ft. in width by 202 ft. in length, the trusses being placed 10 ft. apart, connected by iron purlins and covered with slate. Notice that the roof is arranged to carry shafting at any point on the lower chord, which is considerable of a novelty in an iron roof.

Office and Works: EAST BERLIN, CONN.

JUST PUBLISHED.

1 Vol. 12mo., cloth, $1.50.

SLIDE VALVE GEARS.

AN EXPLANATION OF THE ACTION AND CONSTRUCTION OF PLAIN AND CUT-OFF SLIDE VALVES.

BY

FREDERIC A. HALSEY,

MECHANICAL ENGINEER.

FULLY ILLUSTRATED.

ANALYSIS BY THE BILGRIM DIAGRAM.

D. VAN NOSTRAND COMPANY,

23 Murray and 27 Warren Sts., New York.

Copies sent by mail on receipt of price.

JAMES L. WELLS, Auctioneer,

TUESDAY, JULY 22, NOON, at REAL ESTATE EXCHANGE,

59 TO 65 LIBERTY STREET, NEW YORK.

ASSIGNEE'S SALE.

PATENT RIGHTS & ASSETS

appertaining to Sugar Machinery business of S. S. HEPWORTH & CO., and consisting of Twelve Patent Rights for Centrifugal Machinery, Unpaid Judgments and Book Accounts. Full particulars with S. FRANCIS QUICK, Assignee, Yonkers, N. Y., and with the Auctioneer, 59 Liberty St., New York.

THE CELEBRATED

HEALD & SISCO

CENTRIFUGAL PUMPS

Vertical and Horizontal.

COOKE & CO.,

22 Cortlandt St., New York.

In Writing Mention this Paper.

BOOKS

FOR ENGINEERS AND FIREMEN.

THE BEST BECAUSE

They are written in plain, practical language, devoid of theories or mathematical formulæ.

ROPER'S PRACTICAL HANDY-BOOKS.

By Stephen Roper, Engineer.

For sale by all Booksellers. Send for Descriptive Catalogue, *Free* to any *Address.*

EDWARD MEEKS,

PUBLISHER,

No. 1012 WALNUT ST., PHILADELPHIA, PA.

TO INVESTORS OR MANUFACTURERS.

FOR SALE

—A desirable article to manufacture,
—A line of heavy machinery
—Which has been well tested.
—Is now in practical use.
—Secured by Patents.

Address, NOTTAD,

Box 44. E. DES MOINES, IOWA.

THE BRITISH & EUROPEAN PATENT AGENCY,

F. W. BARKER, Manager,

(Registered English Patent Agent According to Act of Parliament,)

252 BROADWAY, NEW YORK.

European Patents obtained at low rates and sold on Commission through London House. *A good invention is worth as much in Great Britain as in the United States.* Competent draftsmen employed on the premises, and special terms allowed inventors also obtaining their U. S. patents through the Agency. (CORRESPONDENCE SOLICITED.)

"Star" Foot Lathe Swings 9x25 in.

LATHE

Screw Cutting Automatic Cross Feed, etc.

Scroll Saws, Circular Saws, Lathes Mortisers.

Catalogue Free of all our Machinery.

Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

WORTHINGTON STEAM PUMPS

SEND FOR NEW EDITION OF GENERAL CATALOGUE

HENRY R WORTHINGTON

88 LIBERTY STREET

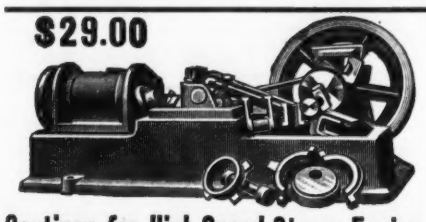
NEW YORK

Established in 1874.

CLEVELAND TWIST DRILL CO.

Corner Lake & Kirtland Sts., Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.

$29.00



Castings for High Speed Steam Engine.

CYLINDER, 4 in. x 4 1-4 in.

T. SHRIVER & CO., IRON AND BRASS FOUNDERS,
333 E. 56th St., N. Y. City.

Sets of Castings for Engine illustrated above, with *Cast-steel Shaft, Connecting Rod* and *Rock Shaft* and *Brass Bearings*, boxed and shipped on receipt of $29.00. Three sheets *blue prints* of working drawings, extra.

DROP FORGING.

SPEIRS & MOORE, WORCESTER, MASS.

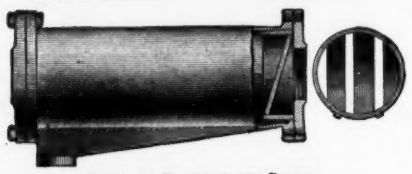
BARNARD'S SEPARATOR

For Separating and Removing Entrained Water from Live Steam;

AND

Condense Water, Oil, Dirt, Etc., from Exhaust Steam.

SPECIAL DESIGNS FOR SURFACE CONDENSERS.



SEND FOR CIRCULAR AND PRICES.

GEO. A. BARNARD,
15 CORTLANDT ST., NEW YORK.

I. P. RICHARDS PROVIDENCE R.I.

NEW STANDARD PUNCHES. No 2 11/16

BEST SYSTEM on Earth for PUNCHING IRON AND STEEL.

STEAM

PARK Double Jet INJECTOR

TO THE BOILER

WATER

PARK MFG. CO.,
53 Portland Street,
Boston, Mass.

THE most reliable under varying steam pressure of any injector known. Will work from 15 pounds to 180 pounds without any adjustment. The only **Automatic Injector** that will thoroughly drain itself when shut off, thus preventing freezing. *Every Machine Guaranteed.*

INJECTORS AND JET APPARATUS.

BEVEL GEARS,

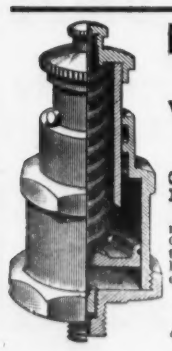
Cut Theoretically Correct.

For particulars and estimates apply to

HUGO BILGRAM,
Machinist,
Successor to
BREHMER BROS.,
440 N. 12th St., Philadelphia, Pa.

STUBS PATTERN — FILES — NEEDLE FILES — RIFFLERS — GROBET PATTERN STUBS — WORLD'S BEST IN THE

McFADDEN CO.,
1025 MARKET ST., PHILADELPHIA.



LACKAWANNA GREASE CUP

Will Save Its Cost in Oil alone Several Times per Annum.

SAVES ALSO IN LABOR AND COST OF COTTON-WASTE, PREVENTS DRIPPING AND SPATTERING.

A POSITIVE FORCE FEED with the most PERFECT REGULATION and GREATEST CONVENIENCE in operation yet attained in any device for the lubrication of machinery. Works equally well in every possible position.

Lackawanna Lubricating Co.,
41 Coal Exchange, Scranton, Pa.

SOME NOTABLE ARTICLES

APPEARING IN BACK ISSUES OF THE

AMERICAN MACHINIST.

The following list is published to facilitate the ordering of back numbers containing them. Any of these issues can be ordered through any newsdealer, or of the publishers direct, at the price then ruling, viz.: 5 Cents a Copy.

1886.

Pattern Making, Various Articles on. By F. W. Barrows. Appearing in 29 issues.
Foundry Practice, Various Articles on. By Robt. E. Masters, appearing in 16 issues.
Strength of Different Mixtures of Cast-iron and Method of Testing. By Robt. E. Masters, April 24.
Foundry Practice, Articles on. By Foundryman. [L. C. Jewett.] Aug. 14, Sept. 25, Dec. 18.
Foundry Practice, Articles on. By S. Bolland, May 8 22 29, June 26, July 10.
The Morton-Poole Roll Grinding Lathe. By Joshua Rose, J. G. Tramis, Geo. H Babcock and C. A. Smith. July 3, 24, Aug. 7, 14, 21, Sept. 25.
Machine Shop Cost and Time Accounts. By A. J. Shaw, Henry Metcalfe and C. A. Burton, April 3, 17, May 8.
Tests of Iron. By David Spence, April 17, Oct. 30.
Traction on Grades. By A. B. Ropes, Oct. 30.
Wilson's Valve Gear for Locomotives, Oct. 30.
Casting Face-plates Face Up. By David Spence, Oct. 23.
A Job of Shaft Straightening. By F. L Johnson, Oct. 23.
Inventory Valuation of Machinery Plant. By Oberlin Smith, Aug. 7.
Making a Cast-iron Sheave. By P. S. Dingey, July 31.
New Dredge Boiler designed by Norman Wheeler, July 17.
Core Oven with Rotating Back. By Thos Wathey, July 24.
Universal Table for Lathe Change Gears for Screw Cutting. By Joshua Rose, July 24.
Gating, Clamping and Securing Chaplets. By Matthew Wiard, May 1.
Printing Frame and Manner of Making Blue Prints. By C. L. Redfield, July 31.
Some Pressure Tests. By C. O Sine, Nov. 27.
An Expanding Mandrel—Turning Tapers. By Chas. S Beach, Nov. 27.
Core Making in Foundries. By David Spence, Nov. 20.
Making Pattern for Spiral Grooved Drum. By Geo Allge, Aug. 14
Rolling Conic Sections Applied to Gears. By Geo B. Grant, Nov. 6.
Ninety-inch Belpaire Fire-box Boiler, Nov. 6.
Spacing in the Milling Machine. By Chas. S. Beach, Aug. 21.
Engine Crossheads. By J. G. Tramis, Aug. 21.
Traction and Adhesion. By A. B. Ropes, Aug. 28.
Internal Key-seating on Milling Machines. By A. B Landis, April 17.
Tapping Holes in Boilers. By A. B. Landis, April 24.
How to True Emery Wheels. By L. Best, April 24.
Work and System in the Drawing-room. By C. L. Redfield, Aug. 28.
Oiling Lathe Carriage Ways. By Wm. H. Bradt, Aug. 28.
Moulding a Screw or Worm without Cores. By George Allge, Sept. 11, 18.
Power Absorbed in Cutting Cast-iron. By James F. Hobart, Sept. 11, 18.
Moulding Screw Propellers in Loam. By Chas. A. Devlin, Sept. 18.
Dimensions of Wrought iron Pipes in England. By A. G. Brown, Sept. 4.
Truing Up and Replacing Milling Machine Centers with Accurate Alignment. By A. B. Landis, Jan. 16.
Methods of Working and Tempering Steel. By S. W. Goodyear, Jan. 9.
Slotting Tool. By J. J. Bingley, May 8.
How to Make Clean Solid Castings at Least Possible Cost. By Matthew Wiard, April 10.
Truing Milling Machine Centers. By W. R. Ballou, April 10.
Lining Engine Lathes. By Chas. S. Beach, April 10.
Steam Piping. By J. G. Tramis, April 10.
An Equalizing Dog. By A. B. Landis, April 10.
Screw Cutting Dies. By John J. Grant, April 10.
Some Handy Shop Tools. By Fred. H. Colvin, April 3.
Moulding Bells for Blast Furnaces in Green Sand Without Patterns. By Geo. O Vair, April 3.
Furnace for Heating Long Bars. By W. G. Richards, April 3.
Cutting Tools—Roll Turning. By S. W. Goodyear, Oct. 16.
Hydraulic Forging. By J. Richards, July 10.
A "Box" Jig. By C. E. Simonds, June 19.
Cheap Testing Machine. By Wm. Merrill, Feb. 6.
Boring Deep Holes. By A. B. Landis, Mar. 27, May 8.
Working Steel and Iron. By S. W. Goodyear, Feb. 13.
Inventory Valuations of Patterns. By W. E. Matheson and others, Jan. 9, Feb. 13, 20, Mar. 6.
Making Cast-iron Half Boxes. By A. J. Shaw, Feb. 6.
Draining Steam Pipes. By W. E. Crane. Feb. 6,
Brazing and Welding Iron. By J. F. Hobart, Mar. 6.
Deep Holes by Continuous Boring. By A. B. Landis, Mar. 27.
Slotting Machine Tool. By Wm. Foster, Mar. 20
Compound Engines for Stationary or Factory Purposes. By W. H. Hoffman, April 24, May 1, 22.
Engineering Subjects, Articles on. By W. H. Hoffman, Mar. 13, July 24, 31, Aug. 21, Oct. 9.
Self-contained Engines. By W. H. Hoffman, Feb. 27, Mar. 6.
Curving Qualities of Locomotives with High and Low Centers of Gravity, Oct. 16.
Making Large Spur Gear Wheels. By P. S. Dingey, Oct. 2.
Normal Theory of the Gear Tooth Curve. By Geo. B. Grant, Mar 13, 20, Oct. 9.
Return Tubular Boilers. By Wm. Lowe, Nov. 27, Dec. 4.
Chimneys for Steam Boilers. By Wm. Lowe, Mar. 27, May 15. By F. A. Halsey, May 1.
Railroad Cost Cards and Expense Sheets, April 24.
The Milling Machine—Its Construction and Uses. By John J. Grant, Mar 20.
Mechanical Arrangements of the N. Hudson County Cable Railway, Mar. 20.

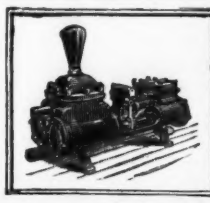
HALL DUPLEX STEAM PUMPS.

Send for 1890 Catalogue.

Fire Pump.

HALL STEAM PUMP CO.,
91 LIBERTY ST., NEW YORK.
PITTSBURGH. CHICAGO. ST. LOUIS.

Boiler and Pump Combined.



THE BUFFALO STEAM PUMP CO.
BUFFALO, N.Y. — MANUFACTURERS OF
STEAM PUMPS
FOR ALL DUTIES.

Maslin's Patent Steam Pump.
Pat. Feb. 12, & Dec. 3, '89.

Cheapest and Best Automatic Steam Vacuum Pump. Handling DIRTY and GRITTY LIQUIDS without Wear, Oil or Care. Simple, Economical, Efficient & Durable. Pumping Plants for Contractors, Irrigation, Water Works, Railroads, Mining & General Hydraulic Purposes. Write or call for Circulars. JOHN MASLIN & SON, SOLE MANUF'RS, 165-167 1st St., Jersey City, N. J.

COMPLETE STEAM PUMP
10 SIZES FROM $7 TO $75
FOR WATER SUPPLY TANKS, FIRE PUMPS & ETC.
WRITE FOR PRICES AND DESCRIPTIVE CIRCULARS
VAN DUZEN & TIFT
SOLE MAKERS
CINCINNATI, O.

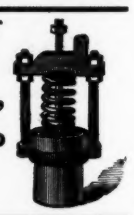
CRUCIBLE AND OPEN HEARTH CAMERON SELF-HARDENING STEEL

ESTABLISHED 1859.

HOWE, BROWN & CO., L't'd, Mfrs., Pittsburgh, Pa.

BRANCH OFFICES: 12 Cliff St., New York. 127 Oliver St., Boston. 228 Lake St., Chicago.

PATENT OILERS, CYLINDER SIGHT FEED CUPS.
Government Regulation
POP SAFETY VALVES,
For Stationary, Marine and Locomotive Boilers.
J. E. LONERGAN & CO., BRASS FOUNDERS AND FINISHERS,
211 Race Street, Philadelphia, Pa.
1888 CATALOGUE FREE ON APPLICATION.



SAWYERS SAY OF SAWS FILED ON ROGERS' SAW FILER AND GUMMER, THAT OF ALL THE SAWS THEY EVER FILED THEY NEVER FILED SUCH SMOOTH AS THESE SAWS

Drop a postal card in the slot and get a Catalogue.
SAMUEL C. ROGERS & CO.,
BUFFALO, N. Y.

STEVENS PATENT
SPRING INSIDE CALIPERS
Ideal No. 65. Price, by mail, postpaid.
3 inch..... ....$1.00 | 5 inch.....$1.25
4 " ..... 1.25 | 6 " 1.50

By using different size nuts we can place them on all sizes of our Ideal Calipers and Dividers. All springs warranted and replaced free of charge when broken from defects in make. Ideal and Leader Spring Dividers and Calipers. Ideal Surface Gauges, Depth Gauges, and Fine Machinists' Tools. *Illustrated catalogue free to all.*
J. STEVENS ARMS & TOOL CO.,
P. O. Box 251, Chicopee Falls, Mass.

THE KEYSTONE HANDLE.

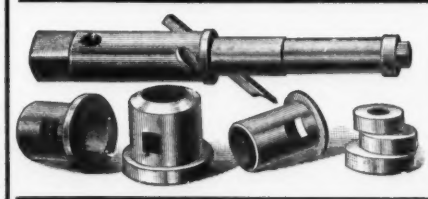
A permanent and reliable method of attaching Hammers and all Edge Tools to Handles. Address,
E. H. BROOKS, LEBANON, PA.

MACHINIST'S SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

LATHE
FOR
TOOL MAKING, MODEL MAKING.

Waltham, Mass.

SCREW CUTTING, GRINDING AND EXTRA FINE WORK.
SEND FOR BOOK OF DESCRIPTION



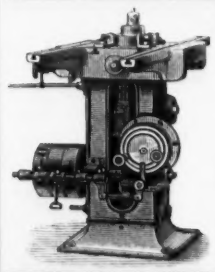
—THE—
Vance Lightning Flue Cutter

For removing Flues from Locomotive and Stationary Boilers. One man can cut five hundred (one end) in a day. In use in the leading Railroad Shops of the country. Combination Cutter for removing 2 in., 2 1-4 in., 2 1-2 in. and 3 in. flues, $50. Sent on approval to Railroad Co's. Liberal Discounts to the Trade.

VANCE TUBE CUTTER CO., Geneva. N. Y.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS

JAS. HUNTER & SON,
North Adams, Mass.



KEY SEATERS

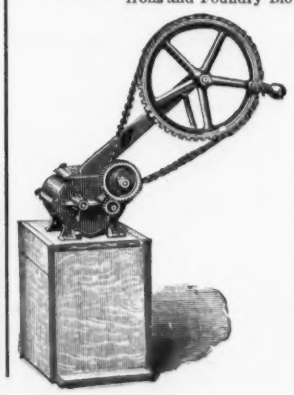
PORTABLE AND STATIONARY.

RACK-CUTTING AND KEY-MAKING ATTACHMENTS.

GIANT KEY-SEATER CO.,
EAST SAGINAW, MICH.

ROOTS' NEW ACME HAND BLOWER.

For Blacksmiths, etc. Slow Speed, Positive Blast. Is Durable, Compact and Cheap; also Portable Forges, Tuyere Irons and Foundry Blowers.



P. H. & F. M. ROOTS, Mfrs.
CONNERSVILLE, IND.
S. S. TOWNSEND, Gen. Agt., 22 CORTLANDT ST., NEW YORK.
COOKE & CO., Selling Agts.,

UNIVERSAL RADIAL RADIAL DRILLING MACHINES
THREE DESIGNS. SIX SIZES.
EMBODY ALL DESIRABLE FEATURES.
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO
CINCINNATI, O. U.S.A.

Please Mention This Paper.

SUGGESTIVE FACTS FOR STEAM USERS.

BEMENT, MILES & CO., PHILADELPHIA.

After the fullest investigation, have just ordered a battery of 402 H. P. of Harrison Safety Boilers for the large addition now being built to their extensive works.

Pamphlet describing and illustrating the type of boiler they selected mailed upon application to

HARRISON SAFETY BOILER WORKS,

Germantown Junction, Philadelphia, Pa.

NEW YORK, N. Y. 41 Dey Street. CHICAGO, ILL. 6 So. Canal Street. ATLANTA, GA. 9 No. Pryor Street. MINNEAPOLIS, MINN. 707 Lumber Exchange.

POND ENGINEERING CO.,

CONTRACTING ENGINEERS,

Engines, Boilers, Pumping Engines, Feed Pumps, Feed-water Heaters and Purifiers, Injectors, &c.

Send for ILLUSTRATED CIRCULAR.

St. Louis. Chicago. Kansas City. Omaha.

THOS. H. DALLETT & CO.

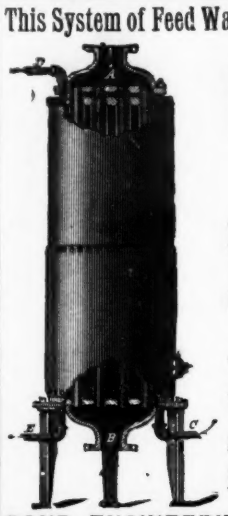
1305 Buttonwood Street,

PHILADELPHIA, PA.

Portable Drills, Hand Drills, Boiler Shell Drills, Light Drill Presses, Special Machinery.

SEND FOR CATALOGUE.

This System of Feed Water Heater is the Best



AND THE

LOWE

is the simplest

HEATER

on the System.

Has Straight Tubes

With reliable provision for expansion, and will

HEAT AND PURIFY THE WATER

EQUAL TO ANY

With same Feet of Heating Surface and

Wear the Longest.

Send for description and Histories of Boilers and Feed Water Heaters to

Bridgeport Boiler Works

Bridgeport, Conn.

POND ENGINEERING CO., AGENTS, ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA.

WESTCOTT CHUCK CO., Oneida, N.Y., U.S.A.

MANUFACTURERS OF

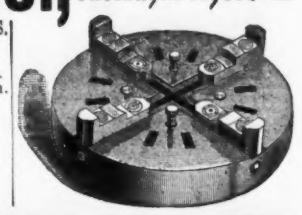
LATHE and DRILL

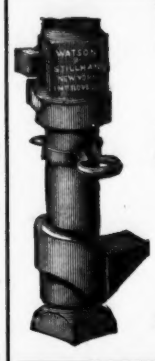
CHUCKS.

SEND FOR ILLUSTRATED CATALOGUE.

Geared Combination Chucks.
Both 2 and 4 Jaw.
Jaws Reversible.

Diameter.	Capacity.
5 inch.	5 inch.
7¼ "	7¼ "
10⅜ "	10⅜ "
13 "	13⅛ "
15¼ "	17 "
18 "	19¾ "
21 "	25½ "
24 "	28 "





Hydrostatic Machinery

PRESSES, PUMPS, PUNCHES,

ACCUMULATORS,

JACKS, VALVES, FITTINGS, &c., &c.

WATSON & STILLMAN,

204, 206, 208 & 210 E. 43d ST.,

NEW YORK.

VOLNEY W. MASON & CO.,

Friction Pulleys, Clutches and Elevators,

PROVIDENCE, R. I.

"THE HORTON LATHE CHUCK"

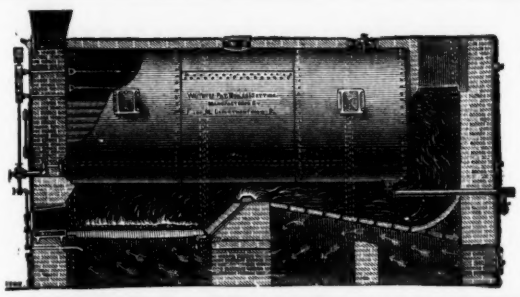
has sustained the tests and been the STANDARD for FORTY YEARS.

Over THREE HUNDRED sizes and styles of Chucks, made and kept in stock, by

THE E. HORTON & SON CO.,

WINDSOR LOCKS, CONN., U. S. A.

SEND FOR ILLUSTRATED PRICE LIST.



Weitmyer Patent Furnace,

For burning screenings, cheap fuel, etc.

Manufactured and Sold by

FOUNDRY AND MACHINE DEPARTMENT,

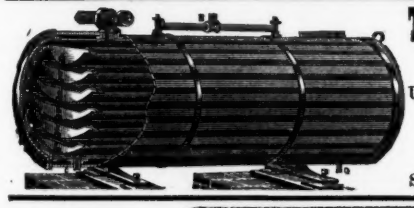
HARRISBURG, PA.

Ide Auto. Engines. Portable and Traction Engines. Steam Road Rollers, Boilers of all descriptions.

New York Office, FLEMING & KIMBALL, 17 Dey St.

New England Office, JOHN POST, JR. & Co., 70 Kilby St., Boston.

Baltimore Office, THOMAS K. CAREY & BRO., 33 Light St., Baltimore.



The HOPPES Live-Steam Feed-Water Purifier,

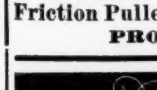
Guaranteed to Prevent Scale in Boilers.

Using any kind of water. Hard Sheet Steel Troughs. *Easily Cleaned.*

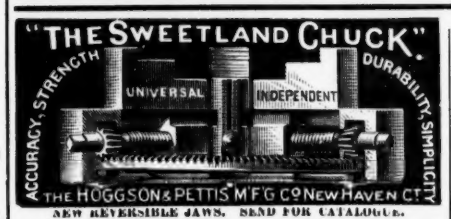
HOPPES MANUFACTURING CO.,

Send for Catalogue D. SPRINGFIELD, OHIO.

WRITE FOR CATALOGUE
THE CHAMPION BLACKSMITH'S LEVER FORGE
The Champion Blower & Forge Co.
MANUFACTURERS OF
STEEL PRESSURE BLOWERS, FAN BLOWERS, EXHAUST FANS, LEVER & CRANK BLOWERS, PORTABLE FORGES, TIRE BENDERS & SHRINKERS, BLACKSMITH DRILLS.
LANCASTER, PA., U.S.A.
THE CHAMPION STEEL PRESSURE BLOWER



"THE SWEETLAND CHUCK".



NEW REVERSIBLE JAWS. SEND FOR CATALOGUE.

AMATEUR'S CHUCKS

BOTH LEVER AND GEARED SCROLL.

DESIGNED FOR FOOT LATHES AND FOR GENERAL MACHINISTS WORK

Send for New descriptive CATALOGUE To THE CUSHMAN CHUCK CO.

Sold by all dealers

HARTFORD, CONN.

CHAMPION SCROLL CHUCKS.

In 5 sizes, for foot Lathes and all classes of light work. Adopted as standard and kept in stock by the largest firms making such machinery. For sale at all supply stores. Ask for our Champion Chuck.

THE D.E.WHITON MACHINE CO.

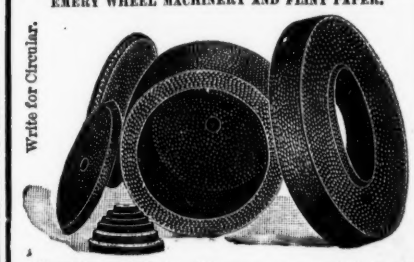
5 OAK ST., NEW LONDON, CONN.

S. A. SMITH, 23 S. Canal St., Chicago, Western Agt.

EMERY AND CORUNDUM WHEELS.

EMERY WHEEL MACHINERY AND FLINT PAPER.

Write for Circular.



All goods manufactured by us are guaranteed to give satisfaction. Give them a trial on their merits.

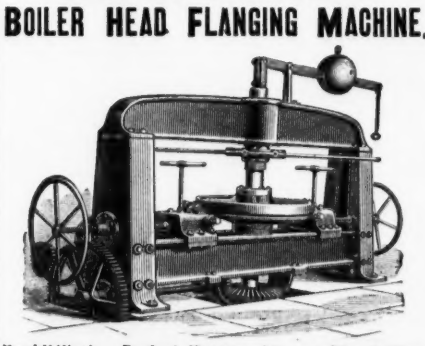
Springfield Emery Wheel Mfg. Co., Successors to Springfield Glue & Emery Wheel Co., Bridgeport, Conn. Western Branch, 18 & 20 West Randolph Street, Chicago, Ill.

CHARLES MURRAY

ENGRAVER ON WOOD

58 ANN ST. NEW YORK.

O'BRIEN'S PATENT BOILER HEAD FLANGING MACHINE.



Rapid Work. Perfect Heads, with or without Dies. No Hole in Plate. Construction Simple. Price Reasonable.

JACOB CLARK, Mfr., Germantown, Philadelphia, Pa.

Steel Balls from 1/16 inch to 2⅜ inch for Anti-Friction Bearings a Specialty.

SEND FOR CATALOGUE.

SIMPSON'S CENTRIFUGAL EXHAUST HEAD.

Thoroughly entraps water and grease from the exhaust of a steam engine without back pressure, preventing them from spraying on the sidewalks and roofs of buildings; it protects the latter from injury, and passers by from annoyance and damage. Send for circular to

KEYSTONE ENGINE & MACHINE WKS.,

5th and Buttonwood Sts., Phila., Pa.,

Or A. T. ARTHUR, Selling Agent, 18 Cortlandt Street, N. Y.

DIXON'S

GRAPHITE

PIPE JOINT

GREASE

For Steam or Gas Pipes, Bolts, Screws, etc.

Far better and cheaper than red lead. Makes a tighter joint than red lead, that can be opened with perfect ease many years after.

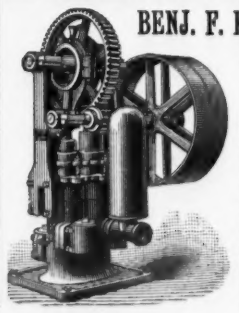
Put up in 1 lb., 5 lb., 10 lb., 25 lb. & 50 lb. packages.

Joseph Dixon Crucible Co.,

MANUFACTURERS PENCILS & GRAPHITE SPECIALTIES.

JERSEY CITY, N. J.

The Economic Boiler & Tank Feed-Pump



BENJ. F. KELLEY & SON,

91 Liberty Street,

NEW YORK.

It is a fact established beyond all dispute that the most economical of all methods of supplying steam boilers with feed water is by the use of a pump driven by a belt. The ECONOMIC PUMP is geared five to one. It is compact and systematic in design, and all parts are arranged for durability.

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND

J. WYKE & CO., TWIST DRILL GAUGE.

Fine Machinists' Tools.—E. Boston, Mass.—Send for Circular.

SPRUE CUTTERS. SHEARS. TOGGLE-JOINT DRAWING PRESSES.

STILL IN THE LEAD!

THE ONLY AMERICAN FIRM

AWARDED

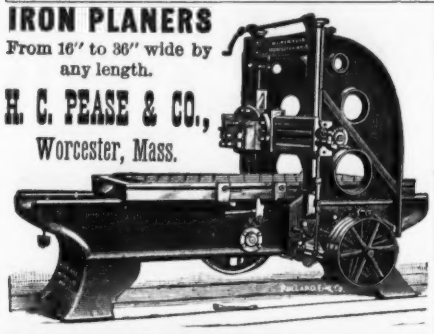
A GOLD MEDAL AT THE PARIS EXPOSITION 1889.

FOR SUPERIORITY IN PRESSES, DROP HAMMERS AND DIES.

THE STILES & PARKER PRESS CO.,

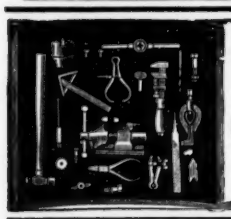
203-207 Centre Street, NEW YORK. MIDDLETOWN, CONN.

IRON PLANERS
From 16″ to 36″ wide by any length.
H. C. PEASE & CO.,
Worcester, Mass.



Pease Iron Planers.
All Sizes from 16 in.x16 in.x4 ft. to 36 in. x36 in.x12 ft. inclusive carried in stock.
HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON, MASS.

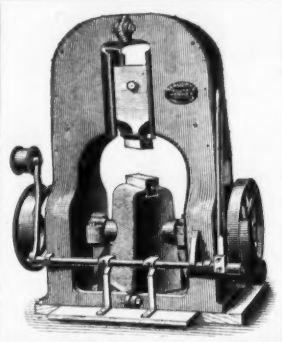
Machinists' Fine Tools
STANDARD TOOL CO., ATHOL. MASS.
SEND FOR NEW CATALOGUE



EVERYTHING FOR
MACHINISTS
in any quantity.
Chandler & Farquhar,
BOSTON, MASS.
Send for Catalogue.

J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.
BUILDERS OF IMPROVED
WOOD-WORKING MACHINERY

Embraces nearly 400 Machines for
PLANING & MATCHING
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, etc.
Variety and Universal
WOOD WORKERS.
Band, Scroll and Circular Saws, Resawing Machines, Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.
W. H. DOANE, Pres. D. L. LYON, Sec'y.

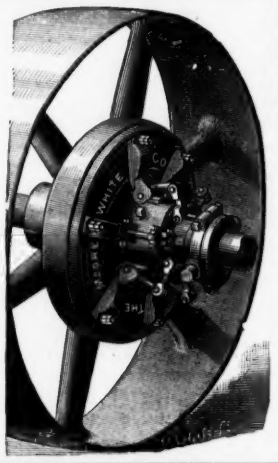


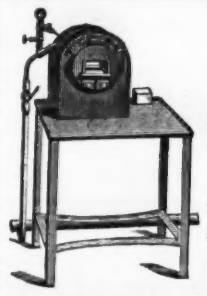
BEAUDRY'S NEW POWER HAMMER.
Send for Descriptive Circular.
BEAUDRY & CO.,
Sole Manufacturers.
Also Manufacturers of
Hard Coal Heating Forges.
Room 4, Mason B'dg.
70 KILBY ST., BOSTON, MASS.

—Novelty Patent Hand Drill.—
A new, ingenious and handy tool for drilling small holes, running at any speed desired. Operator can handle the work with one hand, and the drill with the other.
TINIUS OLSEN & CO.
Mfrs. Testing & Hydraulic Mach'y,
Twelfth and Buttonwood Streets,
PHILADELPHIA, PA.

WELDLESS COLD DRAWN
STEEL QUICK OPENING GATE VALVE. **TUBES**
SMOOTH INSIDE & OUT.
JOHN S. LENG,
4 Fletcher St. N.Y.

THE MOORE & WHITE CO.,
Philadelphia, Pa.
Friction Clutch Pulleys, Cut-off Couplings, &c.





AMERICAN GAS FURNACE CO.,
DESIGNERS AND MANUFACTURERS
GAS BLAST FURNACES.
Send for Catalogue. Estimates made for any mechanical operation requiring **high, even** and **controllable temperature.**
No. 80 NASSAU STREET, NEW YORK.

HEAVY AND LIGHT **CASTINGS** IRON OR BRASS
ARTHUR R. KING FOUNDRY & MACHINE WORKS,
ERIE, 11th & 12th STS., JERSEY CITY, N. J.
GENERAL MACHINE WORK. CORRESPONDENCE INVITED.

FINE TAPS, DIES, REAMERS, ETC.

LIGHTNING AND GREEN RIVER SCREW PLATES.
Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-Saving Tools. Send for Price List.
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS.

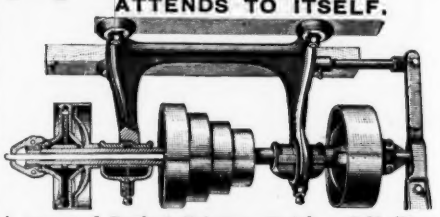
SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap & Machine Screws, Studs, etc.

OUR NEW **CATALOGUE OF TOOLS**
And Supplies sent free to any address on receipt of Ten Cents in Stamps (for postage).
Chas. A. Strelinger & Co., WOOD AVE. Detroit, Mich.

MACHINERY
For Reducing and Pointing Wire.
ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.
For Machines or Information, address the Manufacturer,
S. W. GOODYEAR, Waterbury, Ct.

A MODERN COUNTERSHAFT.
ATTENDS TO ITSELF.



A new and Perfect Friction Clutch. Self-oiling throughout. Self-oiling pulleys that do not spill. Tested by one year's use. Saves care, worry and money.
THE STATES MACHINE CO.
R. R. Place & Commerce St., Newark, N. J.

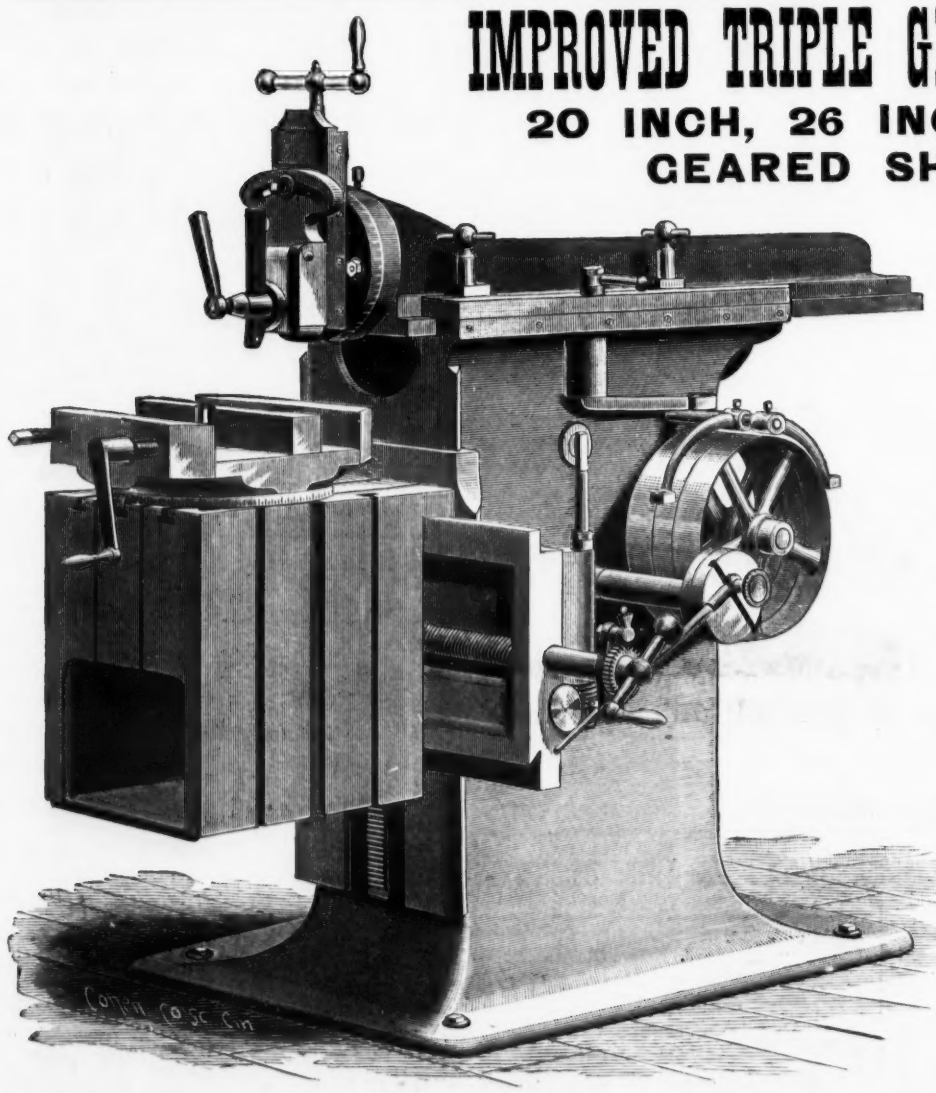
American Standard Gauge & Tool Works,
WILMINGTON, DEL.
Makers of Implements for Standard Measurements.

Over 43,900 in Use.
Crescent Gauge. Flat Bar Gauge.
JAS. A. TAYLOR & CO.

PATENTS
J. M. VALE,
Att'y and Counsellor at Law.
SOLICITOR OF PATENTS.
Atlantic Building, Washington, D.C.
Patent Law a Specialty and special attention to patent cases on appeal to U. S. Supreme Court. Unexceptional references.

ESTABLISHED 1842
ROBERT POOLE & SON CO.
ENGINEERS AND MACHINISTS.
MACHINE MOULDED
GEARING.
ALL KINDS OF TRANSMISSION MACHINERY
OF THE HEAVIEST CLASS.
BALTIMORE, MD.

IMPROVED TRIPLE GEARED SHAPERS.
20 INCH, 26 INCH, 32 INCH GEARED SHAPERS.



☞ Stroke can be changed while machine is running.

☞ A shaft can be passed under the ram through the column and a key seat planed in same to any length.

☞ Each machine complete with indexed swivel vise.

We manufacture also 15 inch and 20 inch Crank Shapers.

EASTERN HOUSE:
64 Cortlandt Street,
NEW YORK.
The Lodge & Davis Machine Tool Co.,
WORKS: CINCINNATI, O.
WESTERN HOUSE:
68 & 70 So. Canal St.,
CHICAGO.

ALUMINUM, $2 PER POUND.

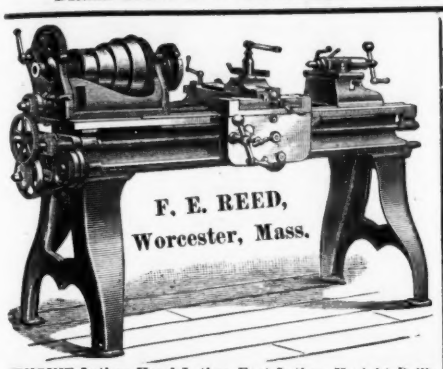
THE PITTSBURGH REDUCTION COMPANY, 95 Fifth Avenue, Pittsburgh, Pa., U. S. A., offer commercially pure aluminum at the following rates at Pittsburgh, Pa.:

Lots of 1,000 lbs. and over.....	$2.00 ℔ lb
Lots of 500 lbs. and over.....	2.25 ℔ lb
Lots of 100 lbs. and over.....	2.50 ℔ lb

Metal guaranteed to be equal in quality to the best metal manufactured by any other process.
Prices on sheets, wire, tubes or castings given upon application.

MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.
Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

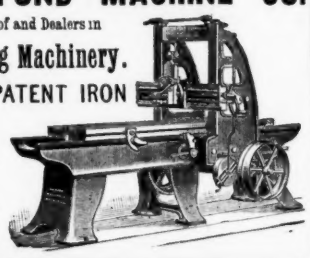
Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.



ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.

FLATHER ENGINE LATHES
14, 15, 16, 18, 20, 24 and 28 INCH SWING.
ANY LENGTH OF BED UP TO 22 FEET.
HILL, CLARKE & CO.,
General Selling Agents,
156 OLIVER ST., BOSTON, MASS.

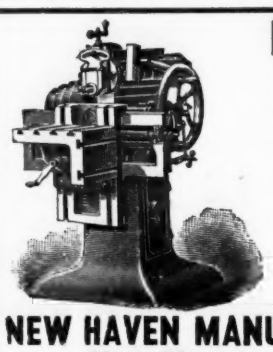
L. W. POND MACHINE CO.
Manufacturers of and Dealers in
Iron Working Machinery.
IMPROVED PATENT IRON PLANERS A SPECIALTY.
152 Union St., WORCESTER, MASS.



FLATHER IRON PLANERS.
SIZES 22, 24, 26 and 30 INCH.
For Immediate Delivery,
Three FLATHER PLANERS, 22"x22"x5 ft.
HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON, MASS.

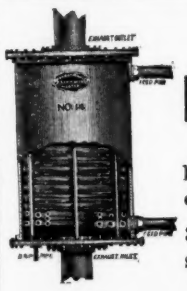
H. BICKFORD,
LAKE VILLAGE N. H.
BORING AND TURNING MILLS, 4, 5 and 6 Ft. SWING.

WILLIAM BARKER & CO.,
Manufacturers of
Iron and Brass Working
MACHINERY,
140 & 142 E. SIXTH ST.,
Near Culvert,
CINCINNATI, O.
Send for Circulars and Prices.



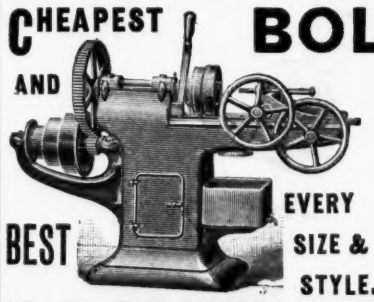
Lathes, Planers, Drills, Slotters, Etc.
NEW HAVEN MANUFAC'G CO.,
New Haven, Conn.

JUST OUT.
OUR NEW ILLUSTRATED CATALOGUE OF
Turret Machinery.
MANY NEW FEATURES.
JONES & LAMSON MACHINE CO.,
SPRINGFIELD, VERMONT.
SEND FOR IT.



THE NATIONAL Feed-Water HEATER.
A brass coil Heater delivering water to the boiler at 210° Fahrenheit.
300,000 Horse Power sold. Prices Low. Satisfaction universal.
THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.

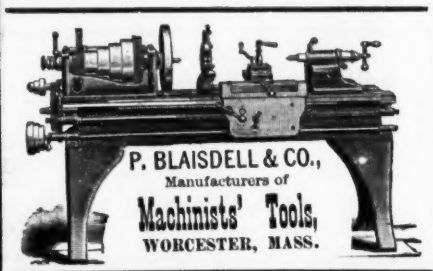
CHEAPEST AND BEST BOLT CUTTERS.



EVERY SIZE & STYLE.
H. B. BROWN & CO.,
EAST HAMPTON, CT.

DRAWING INSTRUMENTS,
200 page Catalogue sent on mention of this Journal, by
C. S. WOOLMAN,
116 Fulton Street,
NEW YORK.

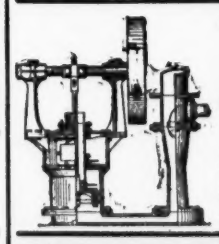
OLMSTED'S UPRIGHT DRILL.
Drills from 5-16 to smallest size with utmost sensitiveness.
No sleeves or collars on spindle to make friction. Spindle and feed lever connected by new adjustable double ball joint. The thrust is directly against center of spindle to feed Drill.
Price $18. Sold by all Machinist Supply Dealers.
SEND FOR CIRCULAR.
L. H. OLMSTED,
Hasbrouck Heights, N. J.



Blaisdell Engine Lathes.
All Sizes from 14 in. to 30 in. swing carried in stock.
HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON, MASS.

BOYNTON & PLUMMER,
WORCESTER, MASS.
Manufacturers of
Shaping Machines,
Drilling Machines,
Bolt Cutting Machines.
Send for Catalogue.

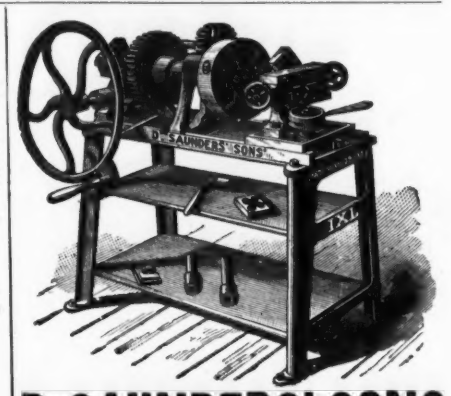
Bolt and Nut Machinery.
SECOND-HAND TOOLS For Sale Cheap.
1" Acme Bolt Cutter, old style frame.
No. 4½ Schlenkler Bolt Cutter (old style), cuts to 1¾"
No. 5 Schlenkler Bolt Cutter (new style), cuts to 2"
Double Schlenkler Bolt Cutter (new style), cuts to ⅞"
Double Lewis, Oliver & Phillips Bolt Cutter, cuts to 1⅛"
National Double Rapid Bolt Cutter (old style frame).
3-Spindle Belt Nut Tapper.
6-ft. Compound Shaper (double tables).
12" Crank Planer.
Durfee & Doe Key Seating Machine.
The NATIONAL MACHINERY CO.,
TIFFIN, OHIO.



Belt Power Air Pump and Condenser.
CONOVER & CO.,
CONSULTING AND MECHANICAL ENGINEERS
95 LIBERTY ST., NEW YORK.
No Air Locks 15 to 50 per cent fuel saved or equal amount of power gained. Runs with same economy as engine.
Adapted to all kinds of Engines. *Send for Circular.*

CURTIS & CURTIS,
66 Garden St., Bridgeport, Ct., U. S. A.
MANUFACTURERS OF
The Forbes Pat. Die Stock,
IMPROVED AND PERFECTED.
Pipe Cutting and Threading Machine, etc.
A portable cutting and threading machine with which one man can with ease thread pipe up to six inch diam. No vise is required.
SEND FOR ILLUSTRATED CATALOGUE.
Ratchet Drills, Ratchet Die Stocks and Malleable Iron Pipe Vises.

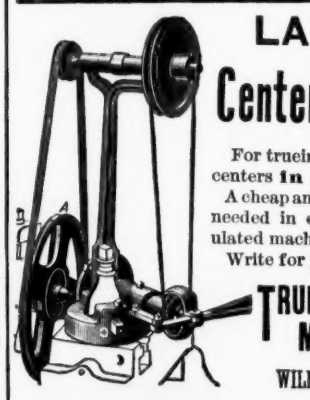
Superior Swiss Drawing Instruments, Extra and Best Quality, German Drawing Instruments, Paragon, Duplex, Universal, Anvil Drawing, Hellos, Blue Process Papers, Scales, Triangles, T-Squares, Drawing Boards, Standard Profile and Cross-section Papers.
Catalogue to professional people on application.



D. SAUNDERS' SONS
MANUFACTURERS OF THE ORIGINAL
TRADE **I. X. L.** MARK.
PIPE CUTTING & THREADING MACHINE.
BEWARE OF IMITATIONS.
None genuine without our Trade-Mark and Name.
Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.
Send for Circular. YONKERS, N. Y.

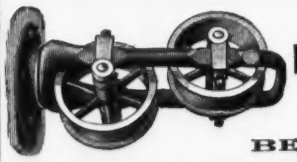
BARNES' PATENT UPRIGHT DRILLS.

20 to 42 inch swing, with both worm and lever feed, self-feed and back-geared
Barnes' Patent Friction Driver, Sensitive Drill. Single and Multiple Spindle.
Barnes' Patent Engine Lathe.
15 inch swing, 6 foot or 8 foot bed.
They have advantages not found in other machines in this line. It will pay parties desiring to purchase or know more about these machines to send for full description and prices to
W. F. & JOHN BARNES CO.,
ROCKFORD ILL.
Address No. 1995 Ruby St.

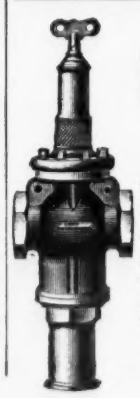


LATHE Center Grinder
For trueing **hardened** centers **in place.**
A cheap and effective tool, needed in every well-regulated machine shop.
Write for prices to
TRUMP BROS. MACH. CO.
WILMINGTON, DEL.

GLEASON MACHINE TOOLS
Engine Lathes, 22 inch to 72 inch swing.
Iron Planers, 26 inch to 84 inch wide.
HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON.

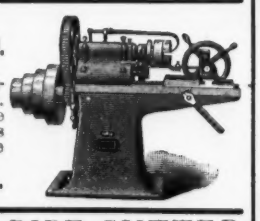


GUIDE PULLEYS FOR LIGHT BELTS.
JOHN ROYLE & SONS, PATERSON, N. J.

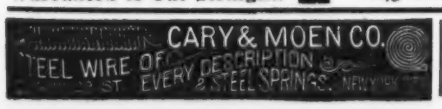


PUMP Pressure Regulators.
This Regulator is the standard used by all the large pump manufacturers; applicable to fire sprinkler systems, to water-works and other pumping machinery.
MASON REGULATOR CO.,
BOSTON.

ADAMS Automatic Bolt-Threading & Nut Tapping Machine.
Made in all Sizes to Cut from 1-4" to 6".
The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to
Capitol Mfg. Co., 125 to 137 Rees St., Chicago, Ill., U. S. A.

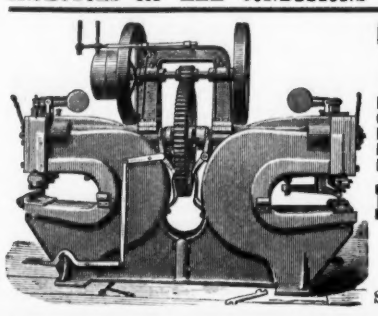


THE "EUREKA" PIPE CUTTER
IS THE BEST AND CHEAPEST MADE.
No. 1 Cuts ⅛ to 1 inch Pipe $1.00
No. 2 " ¾ to 2 " " 1.50
No. 3 " 1 to 2 " " 4.65
Nos. 1 and 3 will cut all sizes from ⅛ to 3 inch
Any Jobber can furnish this tool to you at these prices.
A NEW JAW about once a year will make this Cutter last until you forget when you bought it, as the body never wears out.
Warranted to Cut Straight.
PANCOAST & MAULE,
243 and 245 South Third Street, Philadelphia.

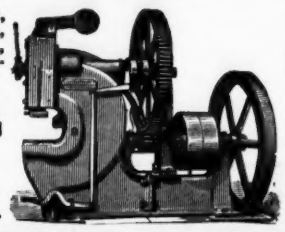


W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

WILLIAM SELLERS & CO., Incorporated.
PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE.



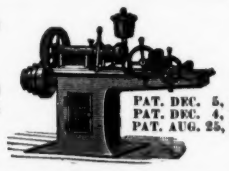
THE LONG & ALLSTATTER CO. Hamilton OHIO.
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
Punches and Shears,
OVER 300 SIZES.
ALSO
Power Cushioned Hammer.
Send for New Catalogue.



OPEN SIDE IRON PLANERS FOR IMMEDIATE DELIVERY.
One 30 in.x25 in.x6 ft.
One 30 in.x25 in.x6 ft. with Extra Side Head.
Two 30 in.x25 in.x8 ft.
One 36 in.x30 in.x8 ft.
One 48 in.x48 in.x14 ft. with Extra Side Head.
One 48 in.x48 in.x16 ft. with Extra Side Head.
Also, One second-hand Bement Planer 42 in.x42 in.x17 ft. with three Heads. Good condition. Very cheap.

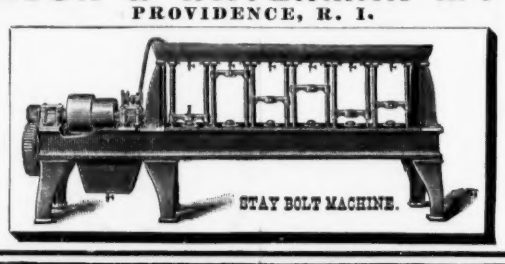
THE DETRICK & HARVEY MACHINE CO.,
BALTIMORE, MD.

ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of
ACME BOLT & RIVET HEADERS,
Acme Single & Double Automatic BOLTCUTTERS.
Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
FIRST PREMIUM, CINCINNATI CENTENNIAL.



PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.

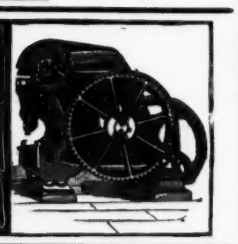
NICHOLSON & WATERMAN M'F'G CO.,
PROVIDENCE, R. I.
LATHES.
CUTTING-OFF MACHINES,
TRAVERSE DRILLS,
TRAVERSE BORING MACHINES,
SPECIALS,
&c., &c.



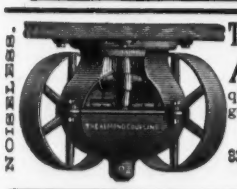
STAY BOLT MACHINE.

BOLT & NUT MACHINERY.
BROACHING MACHINES,
FACING MACHINES,
BOLT LATHES,
STAY BOLT THREADERS,
&c., &c.

PUNCHING AND SHEARING MACHINERY
AND BOILER MAKER'S ROLLS.
NEW DOTY MANUFACTURING CO.
JANESVILLE, WISCONSIN.



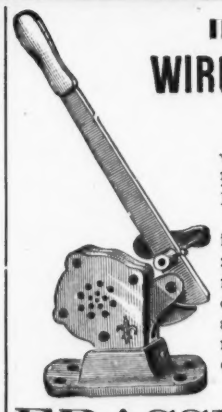
NOISELESS.



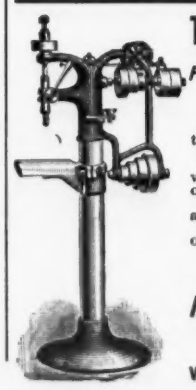
The Almond Coupling
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, MFR.,
83 and 85 Washington Street,
BROOKLYN, N. Y.

EMPLOYERS' LIABILITY ASSURANCE Corporation Limited London, Eng.

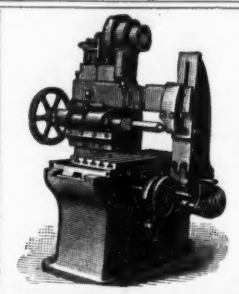
Deposited in the U. S. $700,000.00.
Policies issued giving full protection to Employers against loss by Claims from Employees on account of Accident. Rates Proportioned to Risks of Occupation. One Premium the only Payment during year. No Contingent or other Liability on part of Employer.
CHIEF OFFICE IN THE UNITED STATES:
71 KILBY ST., BOSTON, MASS.
ENDICOTT & MACOMBER,
Managers and Attorneys.
BOSTON: Samuel Appleton, 28 Central St.
NEW YORK: Kirby & Dwight, 51 Cedar St.
PHILADELPHIA: Tattnall Paulding, John G. Hoover, 416 and 420 Walnut St.
CHICAGO: Geo. A. Gilbert, 226 and 228 La Salle St.
ST. LOUIS: F. D. Hirschberg Bro., 120 N. Third St.
AGENTS IN ALL THE PRINCIPAL CITIES.



IMPROVED WIRE CUTTERS.
No. 1 cuts wire rods without leaving burr from ¼ in. to smallest size. Price, $7.00 each.
No. 2 cuts sizes from ⅛ in. to smallest size. Price, $12.00 each. Send $1.00 for 550-page illustrated catalogue of fine tools and supplies. No charge made when $10.00 worth of goods are ordered.
FRASSE & CO.,
92 Park Row, New York.

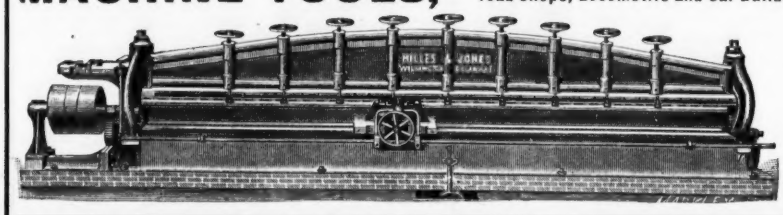


THE NORTON DRILLS.
FOR LIGHT, SENSITIVE AND RAPID DRILLING.
1, 2, 3, 4 or more Spindles, Sensitive or Automatic Feed.
To drill from 0 to 1-2 inch holes.
The *Latest* and *Best*; most convenient, sensitive and durable Drill on the market.
Have Balanced Spindles and Balanced Tables.
Write for prices and description, or for Special Machinery.
NORTON & JONES,
Machine Tool Works,
PLAINVILLE, CONN.
FORMERLY
W. P. NORTON, BRISTOL, CONN.



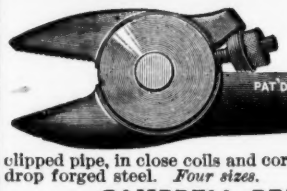
BEMENT, MILES & CO.,
PHILADELPHIA, PA.
—BUILDERS OF—
METAL-WORKING MACHINE TOOLS
FOR
Railroad Shops, Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.

THE HILLES & JONES CO., WILMINGTON, DEL.,
MANUFACTURERS OF
MACHINE TOOLS, For Boiler Makers, Bridge Builders, Ship Builders, Railroad Shops, Locomotive and Car Builders, etc.



Improved Boiler Plate Planer.
Eight Sizes.
8'x20' length of cut.

THE AERATED FUEL COMPANY,
425 MAIN STREET, SPRINGFIELD, MASS. J. H. BULLARD, MANAGER.
FORGING AND WELDING BY PETROLEUM AIR BLAST.
ALL OIL BELOW BURNERS! NO SMOKE, DIRT, OR ASHES!
Represented by WILLIAM PICKETT, SON & CO., 170 Lake St., Chicago; W. S. COLLINS, 171 Broadway, New York. Sept. 29, 1885
CHILON JONES, Gananoque, Can. July 5, 1887
G. M. SMITH, Los Angeles, Cal. July 5, 1887
C. S. BARROWS, 46 Wade Building, Cleveland, Ohio, Michigan and Indiana. Feb. 5, 1889
GILBERT & BARKER MFG. CO., General Agents for the United States, Springfield, New York and Boston. July 23, 1889
THOMAS, SHEPARD & SEARING, Arapahoe Building, Denver, Col.
☞ We will replace in Stock or Mutual Companies any Insurance canceled on account of using this System, when installed according to our plans.



BOYNTON'S ADJUSTABLE ALLIGATOR WRENCH.
Quick and handy in adjustment. Invaluable for work on clipped pipe, in close coils and corners that cannot be reached with other wrenches. Made entirely of drop forged steel. *Four sizes.*
CAMPBELL PRINTING PRESS AND MFG. CO., MFRS.
160 WILLIAM ST., NEW YORK. 325 DEARBORN ST., CHICAGO.

Our Location, Foundry Capacity and Machine and Pattern Shop Equipment afford us **special facilities for furnishing HEAVY CASTINGS TO ORDER,** in any quantity up to size 20,000 lbs., or **SMALL CASTINGS** where large quantities are required. Get our estimates and prices before ordering.
ALLENTOWN FOUNDRY & MACHINE CO.,
3d and Walnut Streets, ALLENTOWN, PA.

WYMAN & GORDON,
WORCESTER, MASS.

DROP FORGINGS.

THE CHESTER FOUNDRY & MACHINE CO.,
CHESTER, PA.
Builders of **CRANES** of every type and capacity, **MARINE, PUMPING** and **BLOWING ENGINES, CORLISS ENGINES, HYDRAULIC PRESSES, ACCUMULATORS,** and **SPECIAL MACHINERY** of every description. **CASTINGS IN DRY OR GREEN SAND AND LOAM.**

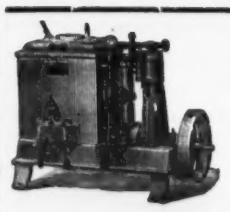
ALL GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS.
"Phosphor-Bronze."
PHOSPHOR-BRONZE
INGOTS, CASTINGS & MANUFACTURES.
THE PHOSPHOR BRONZE SMELTING CO. LIMITED
512 ARCH ST. PHILADELPHIA PA. U.S.A.
ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.

NO MACHINE SHOP CAN AFFORD TO BE WITHOUT
NICHOLSON'S EXPANDING MANDRELS.
Write for new Price List. W. H. NICHOLSON & CO., Wilkes-Barre, Pa.

"PRACTICAL DRAWING."
By J. G. A. MEYER.
This valuable series of 93 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies, 5 cts. each, postpaid.

Order now before our stock of papers is exhausted.
ADDRESS:
American Machinist,
96 FULTON ST.,
NEW YORK.

"MODERN LOCOMOTIVE CONSTRUCTION."
By J. G. A. MEYER.
This valuable series of 106 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $5.30, or single copies, 5 cts. each, postpaid.

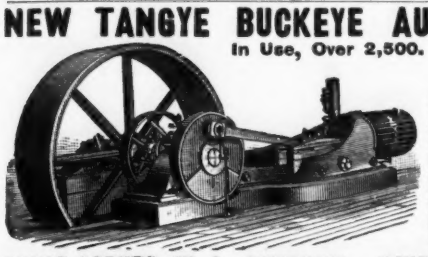


SHIPMAN
Automatic Steam Engine. Kerosene Oil or Natural Gas Fuel
— SAFE, EFFICIENT, DESIRABLE. —
The Best Power for Farmers, Printers, Carpenters and Manufacturers.
Automatic in both fuel and water supply, requiring but little attention after once started.
1, 2, 4, 6 and 8 H. P. Single.
8, 12, 16 and 22 " Compound.
SHIPMAN ENGINE CO., 200 Summer Street, BOSTON, MASS.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES

In Use, Over 2,500.

25 to 1,000 H. P.



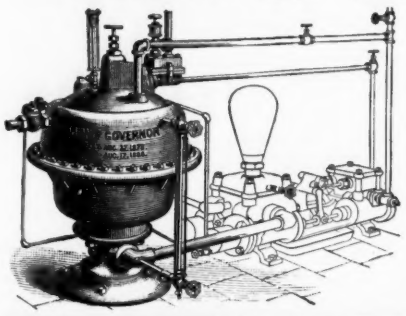
These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

SALES AGENTS: W. L. SIMPSON, 10 TELEPHONE BUILDING, } N. W. ROBINSON, 154 Washington St., Chicago, Ill.
18 CORTLANDT STREET, N. Y. } ROBINSON & CARY COMPANY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland, and Virginia.

BLESSING'S PUMP GOVERNOR.

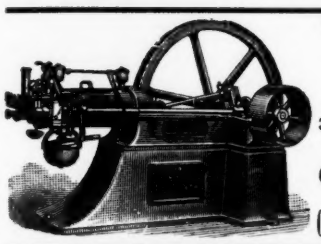


For use in returning the water of condensation to steam boilers under special circumstances, as where the pressure in heating systems is greatly reduced below boiler pressure, or where sufficient head room is lacking. Is used in connection with a steam pump, so controlling the action of the pump that its piston speed is at all times exactly proportionate to the varying quantity of water to be returned. No stuffing boxes are used in its construction, and friction is reduced to a minimum. Can be adapted to suit a wide range of conditions.

Send for circular of **Blessing's Albany Steam Trap, Blessing's Water Circulator and Purifier, and Blessing's Renewable-Seat Stop and Check Valves.**

ALBANY STEAM TRAP CO., Albany, N. Y.

"OTTO" GAS ENGINE WORKS.



SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts., PHILADELPHIA. Branch Office, 151 Monroe St., CHICAGO.

OVER 25,000 ENGINES IN USE.

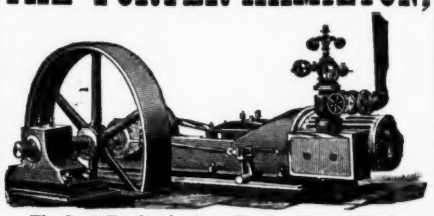
GUARANTEED To consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

SAVE YOUR MONEY BY USING RIDER'S "Victor" Lathe and Planer Tool.

Cutters made direct from bar of Round Steel. *No fitting* required. Send Square or for prices.

FRANK L. B. RIDER, South Newmarket, N. H.

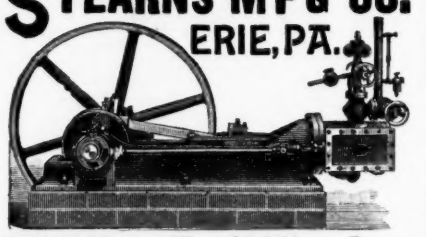
THE PORTER-HAMILTON,



The best Engine in America for Heavy Work.

WILLIAM TOD & CO., Youngstown, Ohio.

STEARNS M'F'G CO. ERIE, PA.



ENGINES from 15 to 400 Horse Power

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

SAW MILLS and GENERAL MACHINERY

NEW YORK STORE, 46 Cortlandt St.

MACHINE TOOLS

For Immediate Delivery.

One Driving Wheel Lathe 70" swing; second-hand.
One Fifield Engine Lathe 30" by 16'; new.
One Lathe and Morse Lathe 32" by 17'; new.
One Lathe and Morse Lathe 36" by 15'; new.
One Gray Planer 30" x 30" x 8'; new.
One Pease Planer 34" x 32" x 8'; new.
One Pease Planer 36" x 36" 8'; special; new.
One Powell Planer 36" x 36" x 12' with 2 heads; new.
One Pond Planer 38" x 38" x 10' with 2 heads; new.
One Powell Planer 48" x 48" x 14' with 2 heads; new.
One Bement Axle Lathe; second-hand.
One Bement Slotter 12" stroke; second-hand.

Send for complete List of New and Second-hand Tools.

HILL, CLARKE & CO.,

156 Oliver St., Boston, Mass.

BRAINARD GEAR CUTTING MACHINES.

18 In., 24 In., 36 In., 48 In.

HILL, CLARKE & CO.,

General Selling Agents,

156 OLIVER ST., BOSTON, MASS.

MACHINE TOOLS

ENGINE LATHES,
BRASS LATHES,
BORING AND TURNING MILLS,
SCREW MACHINES,

on hand and in process of construction.

BRIDGEPORT MACHINE TOOL WORKS,

E. P. BULLARD, PROPRIETOR. BRIDGEPORT, CONN.

MACHINERY ON HAND

Engine Lathe,	14 in. x 6 ft.	Fitchburg,	new
"	14 in. x 6 ft.	Prentice,	"
"	16 in. x 8 ft.	Fitchburg	fair order
"	16 in. x 6-8 ft.	Prentice,	new
"	16 in. x 8 ft	McMahon,	"
"	16 in. x 6 ft.	Lathe swing, 9 in. chuck	fitted good order
"	18 in. x 10 ft.	" " 12 in. chuck	fitted good order
"	18 in. x 8 ft.	Prentice,	"
"	18 in. x 8 ft.	New Haven,	fair
"	20 in. x 10 ft.,	with Taper, Compound Rest and Turret, Bridgeport,	good as new
"	20 in. x 10-12 ft.	McMahon	new
"	20 in. x 10	Wright,	"
"	20 in. x 10 ft.	Fifield,	"
"	20 in. x 8 ft.	Wood light,	good order
"	21 in. x 10 ft.	Fitchburg,	good order
"	25 in. x 10 ft.	New Haven,	fair order
"	28 in. x 14 ft.	Fitchburg,	good order
"	28 in. x 16 ft	Fay & Scott,	new
"	32 in. x 16 ft.	" "	"
"	38 in. x 18 ft.	Leonard,	good order
Pulley Lathes,	39 in., 2 heads,	Niles,	A-1 order
"	26-36-50 in.	Stevens,	good order
Fox Lathes,	several sizes,		"
Turret Lathes,	15-20-40 in.		new
Cabinet Turret Lathe,	No. 2	Am Tool Co.,	good order
Planers,	16 in. x 16 in. x 4 ft	Hendey,	good order
"	22 in. x 22 in. x 5 ft.	Wheeler,	new
"	24 in. x 24 in. x 6 ft.	Lathe & Morse,	"
"	24 in. x 24 in. x 6 ft.	Fitchburg,	"
"	24 in. x 24 in. x 5 ft.	New Haven,	good order
"	26 in. x 24 in. x 8 ft.	Pond,	" "
"	24 in. x 24 in. x 7 ft.	New Haven,	fair order
"	36 in. x 32 in. x 12 ft.	Eastern Mfr.	good order
Shapers,	15in. Stroke, Crank Motion,		new pattern
"	14in. Trav. head,	Fitchburg,	new
"	16 in. stroke,	Eberhardt's Pat.,	"
"	17 in. "	Wright,	"
"	24 in. "	Hendey,	good order
Drills,	20 in. Comb Wheel Lever,	Prentice,	new
"	21 in. Back geared,	"	"
"	24 in. " Self-feed,	F. S.	"
"	25 in. " " "	Blaisdell,	"
"	28 in. " " "	Currier & Snyder,	"
"	28 in. " " "	Prentice,	"
Brown & Sharpe,	No. 1 Universal Miller,		good as new
Garvin	No. 2 Universal Miller,		new
Boring and Turning Mill,	39 in. swing,		"

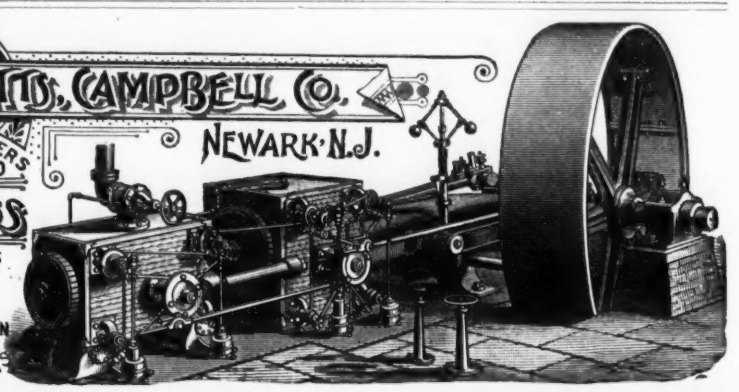
A Large Assortment of other Tools, New and Second Hand. Send for Complete List.

68 Cortlandt St., NEW YORK. | **J. J. McCABE.** Successor to **E. P. BULLARD'S** New York Machinery Warerooms.

THE WATTS, CAMPBELL CO.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N. J.



CONTRACTS TAKEN FOR COMPLETE POWER PLANTS

Eclipse Corliss Engine.

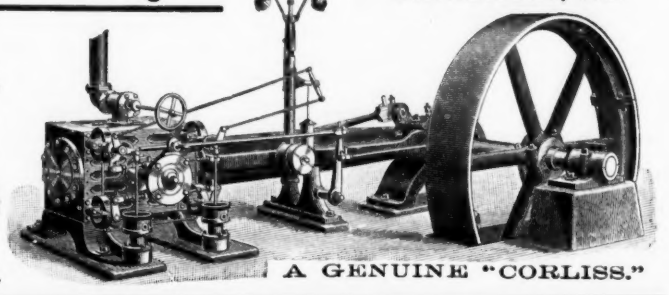
FRICK COMPANY, Builders, WAYNESBORO, PA.

NON-CONDENSING, CONDENSING COMPOUND. 40 TO 1,000 H.P.

Send for Circulars.

ICE-MAKING AND REFRIGERATING MACHINERY.

Send for Special Circular.

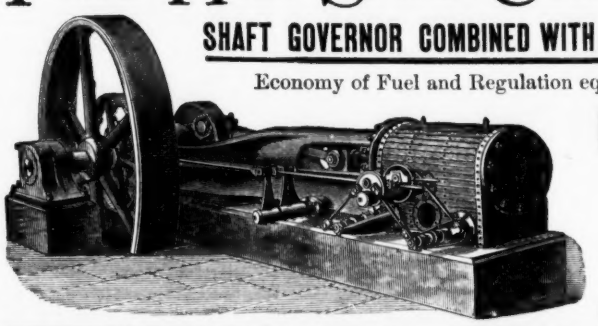


A GENUINE "CORLISS."

PAYNE HIGH SPEED CORLISS ENGINE.

SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.

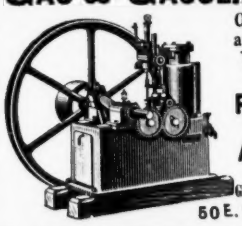
Economy of Fuel and Regulation equal to anything in use.



B. W. PAYNE & SONS,

ELMIRA, N. Y.
45 Dey St., New York.
Hill, Clarke & Co.,
Boston, Mass.
10 S. Canal St., Chicago, Ill.

VAN DUZEN GAS & GASOLINE ENGINE



OPERATED with COAL and OTHER MANUFACTURED GASES AND GASOLINE.

RELIABLE AND ECONOMICAL.

Fully Warranted

VAN DUZEN Gas & Gasoline Engine Co.
50 E. 2d St., Cincinnati, O.

CHANDLER & TAYLOR CO'S SELF-CONTAINED STEAM ENGINES

Are tested under full load before shipment.

12 TO 80 H. P.

IN STOCK FOR QUICK DELIVERY.

For Circulars address

CHANDLER & TAYLOR CO., INDIANAPOLIS, IND

TRAVELING MEN SELLING TO HARDWARE Plumbers, Steam and Gas Fitters, can secure a good side line by addressing Manufacturer, 1448 Niagara St., Buffalo, N. Y.

Corliss Engines

Of the highest type, in all sizes, are made by

The Lane & Bodley Co.

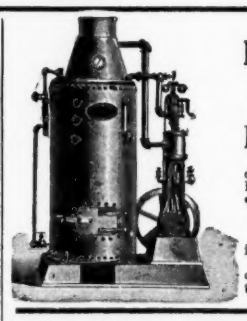
CINCINNATI, O.

The merits of their engines are described in an illustrated pamphlet, which will be sent to any one interested.

FOR SALE. CORLISS ENGINES.

The Fishkill Landing Machine Co., located at **Fishkill, on the Hudson, N. Y.,** offer to manufacturers and others desiring a well-built, economical and durable engine, their improved **CORLISS ENGINES.** They are endorsed by many reputable engineers and persons using them. Address as above.

LANE'S Foundry & Machine WORKS, HUNTINGDON, PA.



Fine Upright Engines.

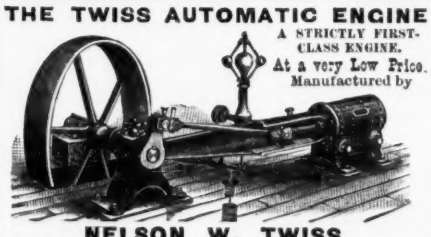
The following sizes are carried in stock, made in large quantities, with special tools, at special prices:

3, 4, 5, 6, 7 & 9 H. P.

If you want one Engine, it will pay you to write us. If you handle large quantities, it will pay you to write us.

THE TWISS AUTOMATIC ENGINE

A STRICTLY FIRST-CLASS ENGINE. At a very Low Price. Manufactured by



NELSON W. TWISS,
25 Whitney Ave., New Haven, Conn.

Send for Price before Purchasing Elsewhere.

ALSO VERTICAL AND YACHT ENGINES.

C. H. DE LAMATER & CO.

have closed their extensive manufactory at the Foot of West 13th Street, New York, and have sold the Hot Air Pumping Engine and Steam Pump business to the De Lamater Iron Works (incorporated in 1889), and the Propeller Wheel business to the Samuel L. Moore & Sons Co., of Elizabethport, New Jersey.

In order to close out the remainder of the stock, offer for sale

A Very Desirable Lot of Machinery,

such as lathes from 15" to 88" swing, planing machines 48"x45"x10', 53"x50"x12', 17"x14"x24', 72"x69"x24', and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.

Punching and shearing machines, for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers, and two 8"x16" and one 10"x20" Rider cut-off engines.

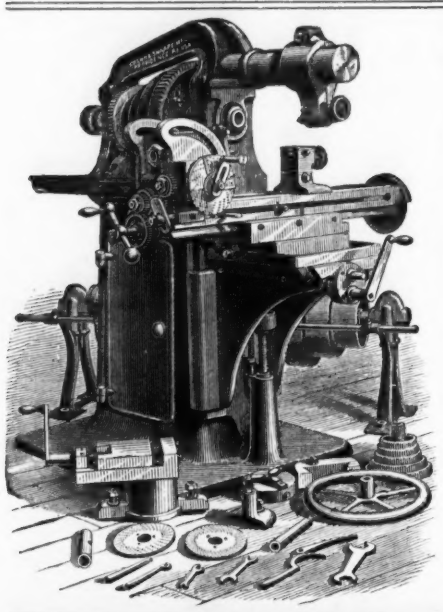
BALL AUTOMATIC CUT-OFF ENGINES,

ERIE, PA.

The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.

CHARLES R. VINCENT & CO.,

NEW YORK SELLING OFFICE, 15 CORTLANDT STREET.



BROWN & SHARPE MFG. CO.,

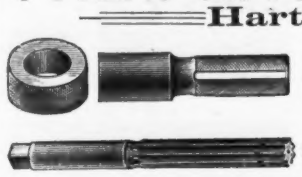
PROVIDENCE, R. I., U. S. A.

MILLING MACHINES.
GRINDING MACHINES.
MILLING & GEAR CUTTERS.
ENGINE LATHES. HAND LATHES.
CHUCKING MACHINES.
STANDARD GEARS. STANDARD GAUGES.
GEAR CUTTING MACHINES.
SCREW MACHINES.

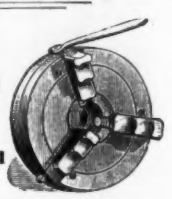
CATALOGUE MAILED ON APPLICATION.

S. A. SMITH,
Western Representative,
23 So. Canal St., CHICAGO, ILLS.

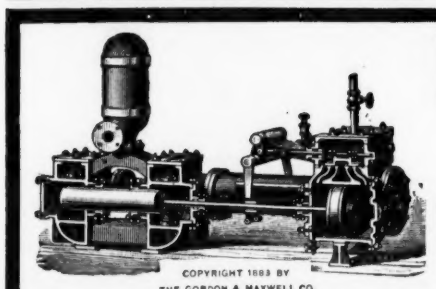
THE PRATT & WHITNEY CO.
Hartford, Connecticut.



MANUFACTURE STANDARD SIZE
Cylindrical and Caliper Gauges,
And End Measure Test Pieces.
Straight and Taper Solid Hand Reamers, Chucking and Shell Reamers, Arbors and Steel Mandrels, Taper Pin Reamers, Combination Lathe Chuck.



PRICE LIST AND DISCOUNT SHEET SENT UPON APPLICATION.
WESTERN BRANCH, 100 West Washington Street, Chicago, Ills.

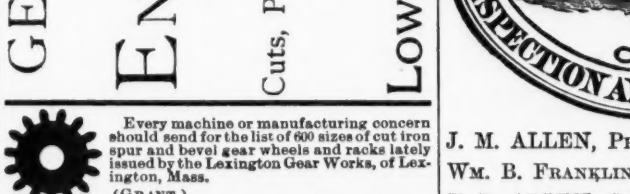


Duplex Steam Pumps
AND
Water Works Machinery.
COPYRIGHT 1883 BY THE GORDON & MAXWELL CO.

THE GORDON STEAM PUMP CO.
HAMILTON, OHIO.

BRANCH HOUSES:
NEW YORK, 98 Liberty Street.
PHILADELPHIA, 705 Arch Street.
PITTSBURGH, Lewis Block.
CHICAGO, Phenix Building.

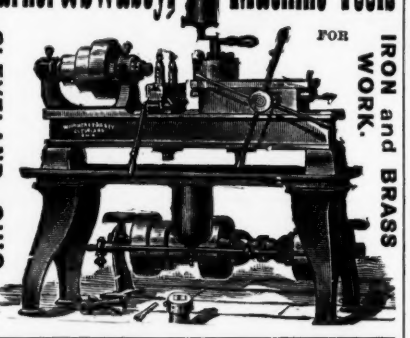
THE BILLINGS & SPENCER COMPANY,
HARTFORD, CONN.,
MANUFACTURERS OF
Billings' Improved Combination Pliers,
Drop Forged from Tool Steel.
DROP FORGINGS in Copper, Iron or Steel, for Electric Motors and Generators, Guns, Pistols, Sewing Machines,
MACHINISTS' TOOLS
AND
Machinery Generally.
Send for Illustrated Catalogue.



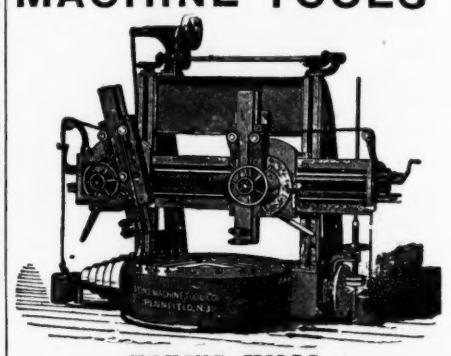
GRANES THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA BOSTON

The Original Unvulcanized Packing
CALLED THE STANDARD—As it is the Packing by which all others are compared.
Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."
JENKINS BROS. 71 JOHN STREET, N. Y. / 105 MILK STREET, BOSTON. / 21 NORTH FIFTH ST., PHILA. / 54 DEARBORN STREET, CHICAGO.

Warner & Swasey, Machine Tools
FOR IRON and BRASS WORK.
CLEVELAND, OHIO.
ILLUSTRATED CATALOGUE ON APPLICATION.



THE POND MACHINE TOOL CO.,
Formerly of Worcester, Mass.
MANUFACTURERS OF
MACHINE TOOLS



BORING MILLS.
Radial Drills, Planers, Lathes, Heavy and Powerful, from new patterns of the latest and best designs.
SALESROOM & OFFICE, 113 Liberty St., N. Y. City
NEW SHOPS, PLAINFIELD, N. J.

FOR IMMEDIATE DELIVERY.

2 BACK GEARED MILLING MACHINES.
3 18 x 6 CABINET TURRET LATHES.
2 15 in. CRANK SHAPERS.
1 20 in. GEARED SHAPER.
1 24 x 24 x 6 IRON PLANER.
4 12 in. HAND LATHES.
3 12 & 15 in. TURRET BORING LATHES.
☞ ALL MACHINES OF OUR LATEST DESIGNS.

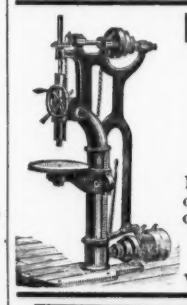
THE LODGE & DAVIS MACHINE TOOL CO.,
WORKS: CINCINNATI, O.
EASTERN HOUSE, 64 CORTLANDT ST., NEW YORK.
WESTERN HOUSE, 68 & 70 S. CANAL ST., CHICAGO.
☞ *SEE ADVERTISEMENT PAGE 16.*

GEO. W. FIFIELD,
MANUFACTURER OF
ENGINE LATHES
FROM 16 to 48 IN. SWING.
Cuts, Photographs and Prices furnished on application.
Lowell, Mass., U. S. A.

Every machine or manufacturing concern should send for the list of 600 sizes of cut iron spur and bevel gear wheels and racks lately issued by the Lexington Gear Works, of Lexington, Mass.
(GRANT)

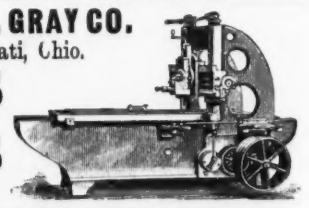
HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER.

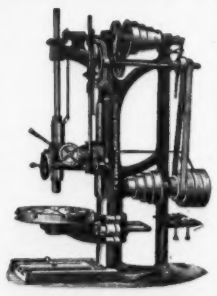


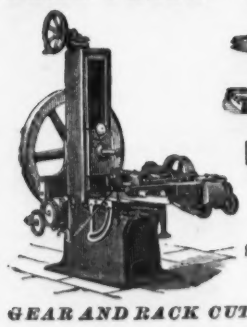
Key-Seating Machines and 20 in. Drills
A SPECIALTY.
SEND FOR LIST OF
New and Second-Hand
Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.
W. P. DAVIS,
Rochester, N. Y.
Works at North Bloomfield.

THE G. A. GRAY CO.
Cincinnati, Ohio.
PLANERS AND LATHES
A SPECIALTY.



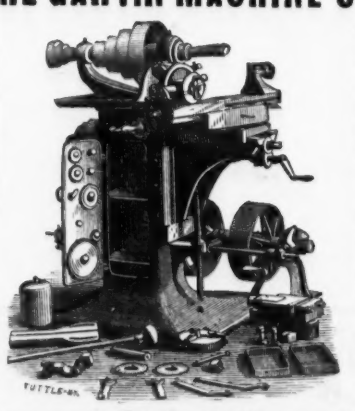
GOULD & EBERHARDT,
Near Market St. Depot,
NEWARK, N. J.
EBERHARDT'S PATENT
DRILL PRESS.





EBERHARDT'S Patent GEAR CUTTER.
Sizes, 18", 25", 36", 50", 60", 84".
GEAR AND RACK CUTTING TO ORDER.

THE GARVIN MACHINE CO.,
Universal Milling Machine.



Manufacturers of Machinists' and Iron Workers' Tools, Lathes, Planers, Milling Machines and Drills. Special Tools for all kinds of manufacturing to order.
Gear and Rack Cutting, Milling and Index Drilling to Order.
LAIGHT & CANAL STS., NEW YORK.

STEEL CASTINGS.
PRATT & LETCHWORTH,
PROPRIETORS
BUFFALO STEEL FOUNDRY,
BUFFALO, N. Y.

THE HENDEY MACHINE CO. TORRINGTON, CONN. SEND FOR OUR CATALOGUE
MANUFACTURERS OF **MACHINE TOOLS**

J. M. CARPENTER PAWTUCKET, R. I.

Manufacturer —of— **TAPS & DIES**